MAY 1960

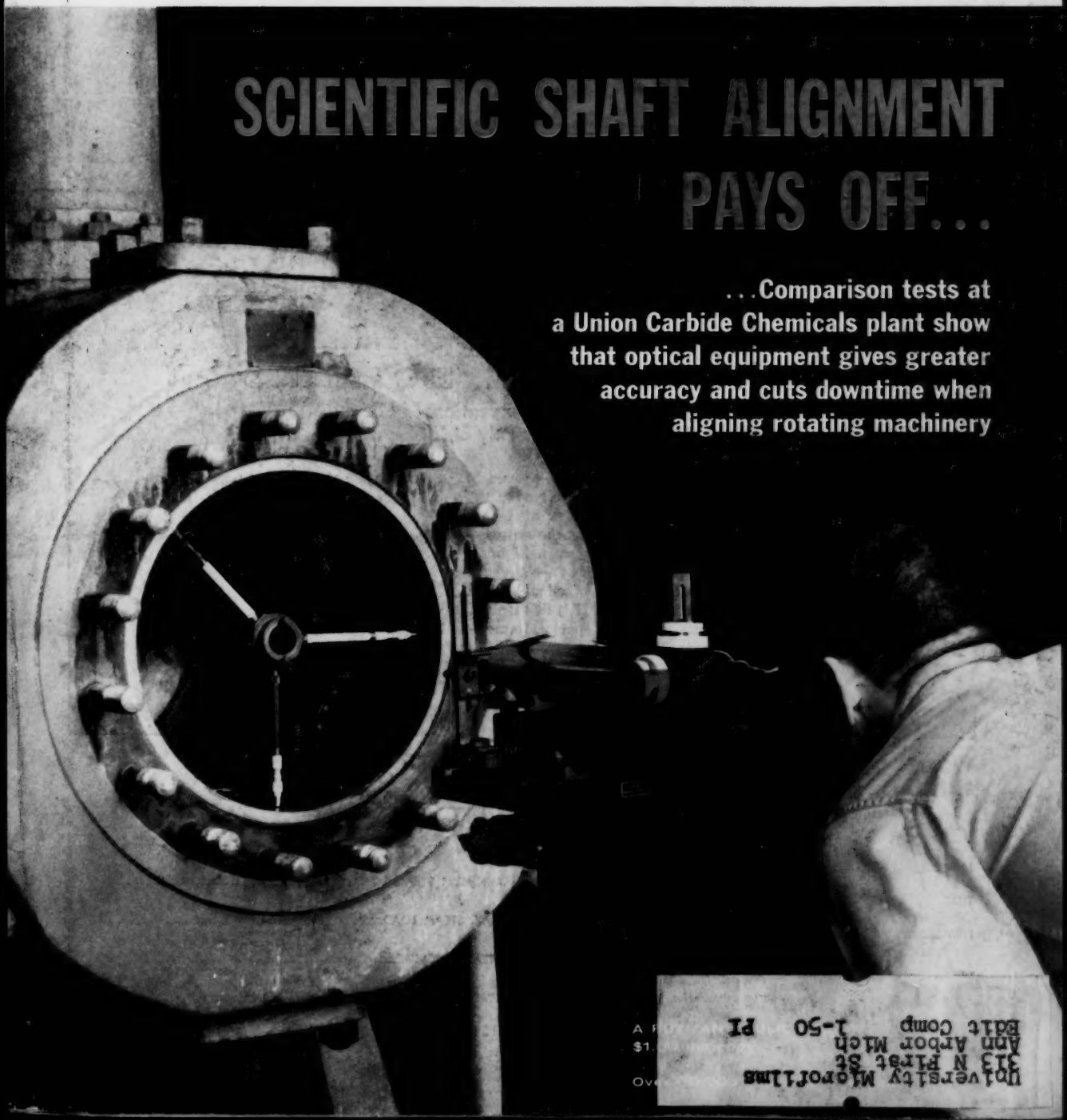
IN THIS ISSUE:

Tips for cleaning air preheater tubes .... page 13
How to get 301 climates in one building .. page 14
Shuts down compressor when malfunctions occur .. page 16

PLUS news reports on new solutions, new developments, and new literature for design, operation and maintenance of plant and power services facilities

Plant and Power Services Engineer

The NEWS Magazine for men who engineer and manage plant facilities



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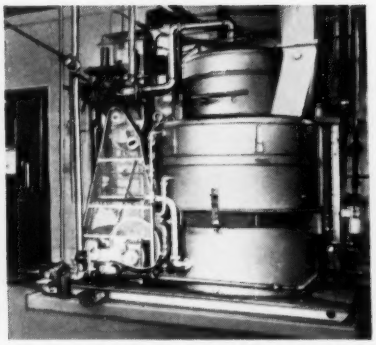

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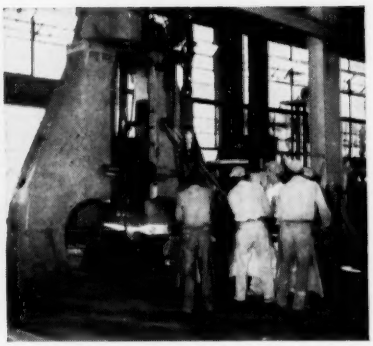

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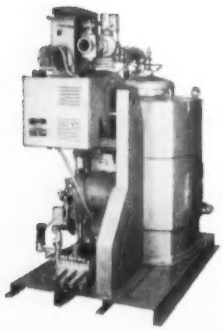

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May 16-20: National Fire Protection Association Annual Meeting; Montreal, Canada.

May 18-20: Industrial Mutual Aid and Disaster Control Conference; Netherland-Hilton Hotel, Cincinnati, Ohio.

May 22-26: ASME Oil and Gas Power Conference and Exhibit; Muehlebach, Kansas City, Mo.

May 23-26: ASME Design Engineering Conference and Show; Statler Hilton, New York, N. Y.

June 6-9: Annual Meeting of National District Heating Association; Grove Park Inn, Asheville, North Carolina.

June 6-17: John Hopkins' Management Course in Operations Research & Systems Engineering; Homewood Campus of John Hopkins University, Baltimore, Md.

June 20-22: ASME Applied Mechanics Conference; Pennsylvania State University, University Park, Penna.

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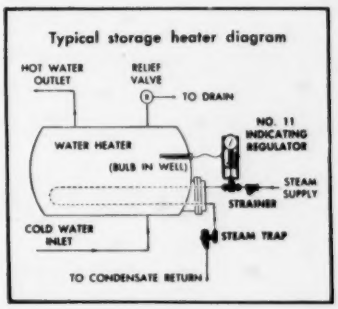

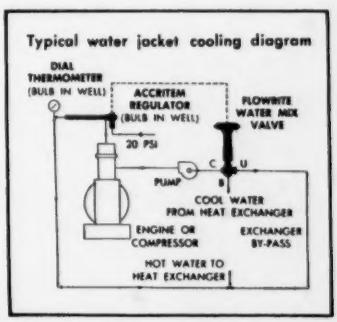

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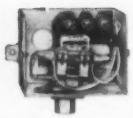

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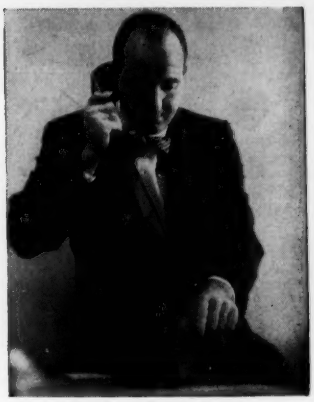

Specifically speaking

There are many ways plant and power services engineers can make sure that their equipment is operating properly. Three of these ways are brought out in our lead articles this month.

First of all, you can make sure the equipment is installed correctly. This is particularly true when it comes to shaft alignment. Take a look at the engineer on the cover of this issue. He is using an optical device to align shafts in compressors. The method is not only very accurate, but it is a lot faster than conventional methods. All the details are given on page 18.

Next, you can install devices to safeguard the equipment during operation. Such a device is described in the story on page 16. At the first sign of any abnormal vibration in the equipment, it will sound an alarm and shut the equipment down.

And, of course, another way is by proper maintenance. One part of a boiler system that is often over-looked during a regular maintenance schedule is the air preheater — especially the tubes. Mr. John of Thomas C. Wilson, Inc., puts forth some handy tips based on his company's experience with cleaning air preheater tubes.

Our fourth story tells how you can get many individual 'climates' in one building. Secret is use of constant-volume mixing boxes in the ventilating system to supply controlled-temperature air to the various zones in the building.

George V. Michael

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MAY, 1960 • VOLUME 2 • NUMBER 5

Plant and Power Services Engineer

Serves the professional, technical and practical interests of the engineers who design, install, maintain and/or operate the plant engineering services and the power engineering services.

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14 Produces and controls 301 'climates' in one building
16 Immediately shuts down compressor when malfunction occurs
18 How to get scientific shaft alignment
22 When you want to eliminate stalling at slow speeds
25 Why not brighten up the plant?
30 Kit contains all for electrical tests
33 Nomographic determination of pipeline sizes

PLUS lots of other news for plant and power services engineers

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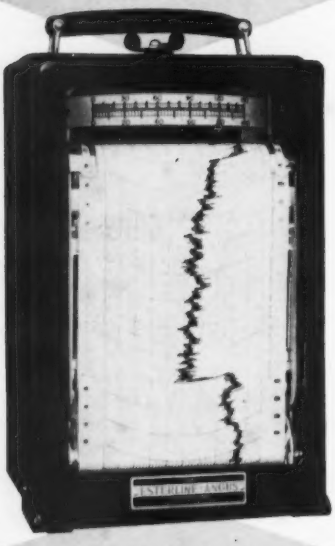

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REPORTS IN BRIEF

Abstracted news of interest to plant and power services engineers

'60s will bring higher incomes

The sixties may go down in history as the "decade of the high income families," according to Karl O. Nygaard, director of business research for The B. F. Goodrich Company Company. By 1970, there will be about 25 million American families with incomes over $7500 a year, Nygaard told a recent annual dinner meeting of the Fort Wayne (Ind.) Engineering Societies. Today, only about 12.5 million families have reached this level.

Of course, this is going to allow more money to be spent on things other than basic necessities. A succession of brief, hectic booms in a wide range of markets such as boats, paintings, adult education can be expected. Quality and mechanical gadgets will become increasingly important, and the consumer will demand more in the way of style and choice, with an alert eye cocked for the uncommon or unusual.

Nygaard said that the over-all level of business activity in 1960 should be up about 5½ percent over 1959. Industrial production should do somewhat better — about 7 percent over last year. Consumer income should show an increase of at least 5½ percent, which will mean a minimum of about $18 billion additional income available for spending this year.

By 1970, the U.S. should achieve a $750 billion economy, representing a 3 percent annual productivity growth.

Another plea for tax depreciation reform

Still another top executive has urged both political parties to support depreciation tax reform to help big and small business in the increasingly competitive world market.

The urgent need to revise our federal tax policy was voiced by James P. Stewart, president of De Laval Steam Turbine Company in his article, "Present Depreciation Practices Stifle Your Company's Growth," in last July's issue of PLANT and POWER SERVICES ENGINEER.

Speaking at the annual meeting of the St. Louis Chamber of Commerce, W. C. Newberg, Chrysler Corporation executive vice president, said the federal tax policy on depreciation allowances for worn-out and obsolete equipment can "literally mean success or failure for American business big and small in its present battle for position in the world market."

Says Mr. Newberg, "It is no secret to anyone that our government is lagging behind the entire world in this respect. Our tax laws and our tax officials continue to duck their responsibility for permitting depreciation allowances sufficient to enable American businessmen to replace non-competitive equipment.

"In drawing up and enforcing tax legislation governing depreciation, they still tend to think primarily about the length of time it takes to tire out a piece of iron, and not about the ever-shorter length of time it takes a competitor—domestic or foreign—to make today's equipment hopelessly inadequate."

"Our federal government should move quickly to strengthen the country—through depreciation tax reform—for the international competitive struggle of the 1960's. It should move toward the goal of allowing business sufficient deductions before taxes to replace its worn-out or non-competitive equipment at the cost entailed now —not at what it cost fifteen or twenty years ago under completely different conditions."

Method lowers brackish water conversion costs

Claims of substantial cost breakthrough in saline water conversion have been announced by Ionics, Inc., Cambridge, Mass. The development of an electric membrane process combined with greater installation economy and more effi-

cient operating methods is said to provide potable water at lower costs in quantities up to several million gallons per day. The electric membrane method is reported to be most efficient in clearing brackish water of less concentration than sea water.

Central air conditioning to cool 7 N. Y. theaters

650-ton unit will meet Shubert Alley's comfort needs

Seven historic theaters will be mechanically air conditioned for the first time next summer by a central system that will link all seven theaters to a master air conditioning system located under famed Shubert Alley in New York.

The theaters will continue to operate while the installation is going on. The new system engineered by Worthington Corp. replaces ice-chilling systems where up to $6000 worth of ice a week—in 350-pound chunks—has been required to cool the theaters. The new system will cost one-tenth as much to operate, and will not only cool but will regulate humidity and provide other advantages as well.

The intricate mass air conditioning challenge will be met by a 650-ton central refrigeration plant in an abandoned boiler room. Chilled water will be piped from the central system to cooling units in the individual theaters.

There will be a constant water flow through the cooling system, and the automatic compressors will be able to operate at varying speeds in order to meet load requirements. Outside temperature changes and varying numbers of persons inside will result in automatic adjustments to maintain constant comfort.

Ratio of installed kvar to peak load kw unchanged in 1959

Ratio of installed capacitor kilovars to peak load kilowatts in the United States remained unchanged at 0.40 during 1959, according to a recent announcement by GE's capacitor department. The historic trend to higher ratios is expected to resume in 1960.

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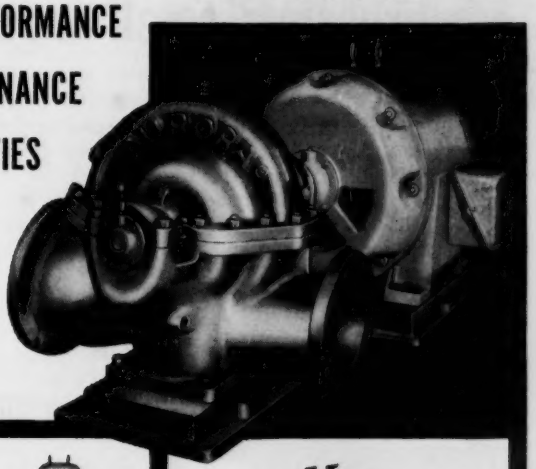
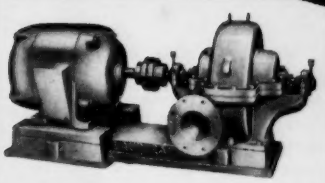
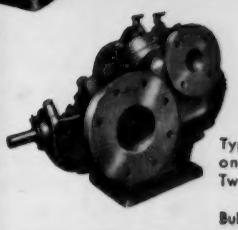


Type OJ Horizontally Split Single Stage Double Suction. Bulletin 105-B.



Type AJ Horizontally Split Two Stage Opposed Suction. Bulletin 106-B.



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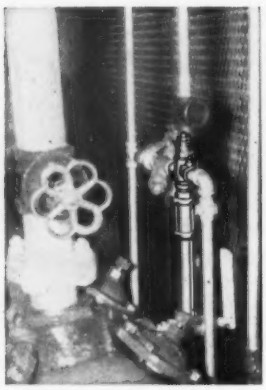
How to save water and prevent over-cooling of compressors, small engines, and hydraulic oil-coolers

When cooling water is controlled manually the operator frequently leaves the valve nearly wide open, in order to play safe if the load varies. The result is over-cooling. If he attempts to vary the flow of water he risks the danger of under-cooling. Automatic cooling controls assure proper cooling at *all* times and effect important economies in water consumption.

And here are three different experiences at Revere Copper and Brass plants which may give you some tips on solving your own cooling control problems.

How Revere Copper & Brass Saved over 50% on water



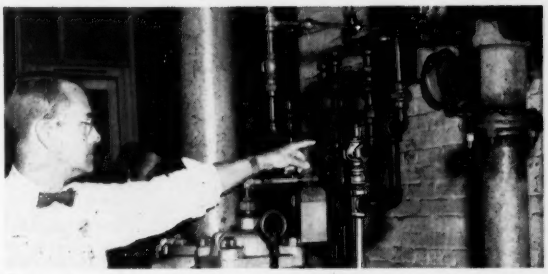
Sarco T-44 automatic cooling control installed at Revere's Riverside plant.

The Riverside, California, plant of Revere Copper & Brass was plagued by over-cooling of compressors. In addition, their water consumption was high — approximately 2,000 gallons an hour. By simply installing Sarco T-44 automatic cooling controls on the compressor cooling lines, plant engineers eliminated over-cooling and cut water consumption about 60%.

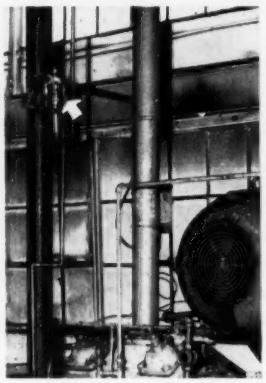
Another benefit was a saving in tool maintenance. (Originally excess moisture was causing difficulty with a large number of air screwdrivers used in the plant.) With the T-44's in service the maintenance problem has practically disappeared.

Manual control was wasting water at Rome Manufacturing Co. Div., Rome, N. Y.

At the Rome Manufacturing Company Division of Revere, at Rome, N. Y., cooling water for air compressors originally was manually controlled. When they installed Sarco T-44 automatic cooling controls on the cooling water lines they made substantial savings in water. They saved damage and maintenance cost on the compressors, too. That's because they eliminated the errors inherent in manual control. Automatic cooling controls always assure optimum cooling by permitting safe operation at the maximum temperature recommended for any given machine or process.



T-44 cooling control on compressor at Rome Manufacturing Co. Div. of Revere. Sarco sales representative Emile Strickland points to control installations.



Installation of a Sarco T-44 on compressor at Rome, N. Y.

Water conservation program at Baltimore led to automatic control

Double target of engineers at the Baltimore plant of Revere was a water conservation program plus tighter temperature control. To achieve both objectives they installed Sarco automatic cooling controls on an air compressor, an aftercooler and a hydraulic oil cooler.

Results were so satisfactory they followed through by installing 50 additional Sarco controls.

For more information on cooling control, contact your Sarco Sales Representative, District office, or write — 2169

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Inside story on automatic cooling control

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Sarco T-44 self-powered cooling control is available in standard 50° adjustment ranges: 60-110° F., 85-135° F., 110-160° F. and 135-185° F. Sizes: ⅜", ¾", ½" and 1".

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Circle 9416 opposite back cover.

Employes urged to join community projects

Recognizing the need for qualified persons to fill public offices, The Timken Roller Bearing Company has put into effect a new policy to encourage employes to take an active part in the affairs of the community.

Should an hourly rated employe be elected or appointed to a local office not requiring the employe's full time, such as a City Councilman, the employe must seek the most appropriate work shift at Timken that best accommodates his political job. For a bargaining unit employe, such action must be taken in accordance with the provision of the Union contract. Approved time off will be paid for at employe's average straight time hourly rate for the last previous week worked.

Basically the same rules apply for an employe elected to a state office—not continuously requiring the employe's full time.

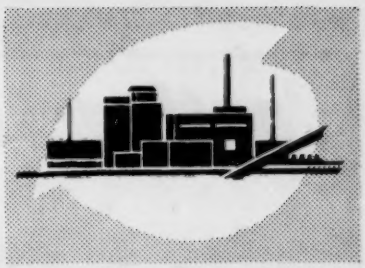
For the employe who is an incumbent of local and/or state office —requiring employe's full time: If employe assumes such office, he will be considered to be a regular quit.

Sees bright future for lighting industry

F. M. Sloan, Westinghouse vice president and manager of the company's lamp division, says that a sharp upward trend in the lamp industry is apparent. He reported that record sales for the industry were set in 1959 and estimated that final figures for the year would show that sales exceeded $425 million.

1959 total lamp market exceeded 1958 by approximately 14 percent, Mr. Sloan reported. A five-year forecast prepared by Westinghouse lamp division economists, indicates that by 1964 the total lamp market will be 50 percent greater than in 1959 at current prices, he said. He reminded the management group that the lamp market historically has doubled itself every ten years.

Says Mr. Sloan, "This dramatic increase in the lighting market comes largely from two sources. The first is the increase in the number of homes, stores, factories, offices and transportation facilities which



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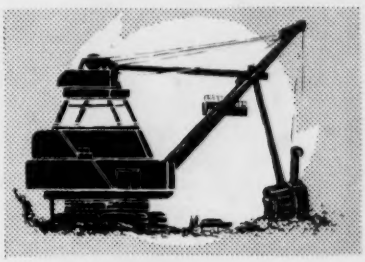

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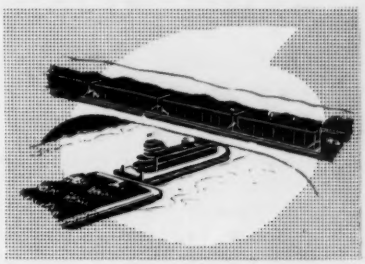

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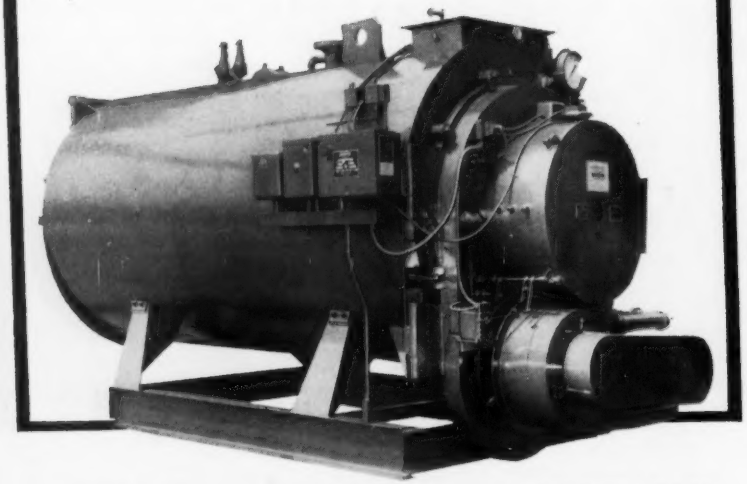
Circle 9417 opposite back cover.

Continental AUTOMATIC BOILERS

2-PASS DESIGN...



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Phoenixville, Pennsylvania
For more information, circle 9418 opposite back cover.

are necessary to supply the needs of the nation's ever-growing population. The second is the increased appreciation and use of light as a means for increasing production, decreasing accidents, selling more goods, helping office employes to be more efficient, and in general, making living more pleasant and enjoyable.

"Studies by lighting experts indicate that if the average office were lighted to the best scientific standards, it would require three times the light furnished at present. It was found that the human eye requires twice and sometimes three times as much light as is generally provided to perform most of today's living and working jobs. It was also revealed that for some tasks, at least twelve times more light would be required for the employe to perform his job at top efficiency.

"The demand for better lighting and higher levels of lighting is just beginning to be felt. No longer is there any question of the value of lighting as a means for increasing production, improving quality, and bettering employe morale. Over the years facts have been accumulated to prove that when factory lighting has been doubled in the 50 to 100 foot candles ranges, production goes up as much as 20 percent, and that the cost of increased light can be offset by a production increase of as little as ½ percent."

Electrical code booklet approved by ASA

The 1959 edition of the National Electrical Code sets up minimum requirements necessary for safety in the use of electricity for light, heat, power, radio, signals, etc., primarily in buildings.

Published by the National Fire Protection Association and approved by the American Standards Association, the revision not only includes many changes in substance, but also a new numbering system. Because of this new system, an appendix is included providing cross reference with 1956 edition. Sections which have been revised since then are indicated in bold face in this appendix.

(Cost of the book is $1.00 and is available from the NFPA or the American Standards Association, Dept. PR, 70 East 45th Street, New York 17, N.Y.)

LETTERS *Your views are welcomed*

in this column. Address "Letters, Plant and Power Services Engineer, 111 E. Delaware Place, Chicago 11, Ill." Letters should be brief and confined to the editorial of this magazine or other topics of interest to the plant and power services function.

Cost information

With reference to the article by Mr. John W. Bishop in your March 1960 issue covering "Power Plant Cost Charts", I would like to obtain information on what the subject costs actually cover.

I have in mind such questions as: are water treating facilities included (if so, what type and what is percent make-up assumed); what is included in the way of fuel handling and storage facilities; how extensive is the building enclosure and what type of building construction is used; is it assumed construction site already has been cleaned and prepared; how many boilers and turbo-generators assumed installed for the various plant capacities indicated; what was assumed as tie-in point for connecting to outside electrical distribution system.

KEITH L. CARTER
General Engineering Dept.
Standard Oil Co. (Ind.)

We find your charts in the March 1960 issue of P&PSE covering boiler plant costs extremely helpful, but would like to know how much is allowed for auxiliaries, such as feed pumps, deaerators, water treating facilities, piping, etc.

EDWIN HILL
Project Engineer
Sun Oil Company

• *Answers to the above questions were supplied by the author, John Bishop. Specifically they are:*
— Cost estimates are based on a two-boiler steam plant and a two-turbo-generator electric plant
— A 30-day oil supply and a 90-day coal supply was generally envisioned (with a 3-4 day bunker or silo capacity)
— Water treating facilities were not broken out from the original tabulation of plant costs and are, therefore, considered to be included in the plant cost estimate. Although this cost will vary widely as a function of percentage makeup and raw water chemical consistency, the treated water consistency is primarily a function of operating pressures, which is one of the variables considered
— The building construction considered, in most instances, was of the steel frame type with corrugated metal or asbestos-concrete sidings. Complete but minimum coverage of the plant was used, except that semi-outdoor boilers were considered in excess of 200,000 lb/hr capacity
— An average site-preparation cost was assumed and absorbed into the overall estimate. Of course, this would not include any extensive removal of existing structures
— All internal plant switchgear, transformers and substations for internal plant operation are included, but the distribution substation is not included, since this is considered as part of the outside distribution system

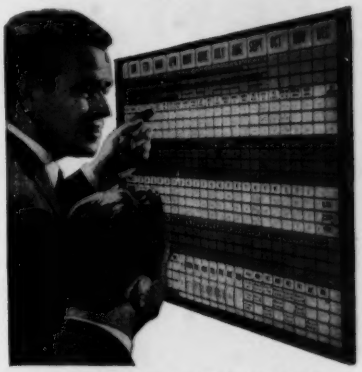
It must be borne in mind that this is a pre-design cost-estimating procedure and that the consideration of all variables in detail would require at least a preliminary design prior to making the cost estimate. This would defeat the quick estimating feature of this system.

In a typical fully automatic oil-fired 90,000 lb/hr central boiler plant (in the Philadelphia area), costing $380,000, an approximate breakdown is as follows:

Instruments and controls (including air compressor) 6.3%
Water treatment (internal and external) 3.2%
Fuel tanks, piping and handling 5.8%
Fuel oil pumping and heating 2.1%
Three feed pumps 1.2%
Deaerator 1.7%
Boilers 26.3%
Condensate collection and piping 0.5%
Breeching 0.7%
Misc. equipment 4.0%

To next page

How To Get Things Done Better And Faster



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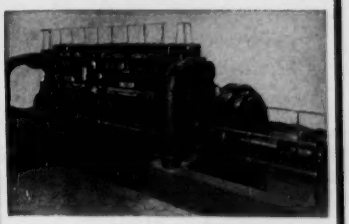

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Circle 9420 opposite back cover.

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Circle 9421 opposite back cover.

LETTERS

From preceding page

Erection, including piping and electric materials 31.0%
Building 13.2%
Clearing and misc. foundation work 4.0%

— *The Editors*

Wants to use charts

We found most interesting the article on page 21 of your March 1960 issue, entitled "Power Plant Cost Charts Have Been Revised." Because of its value to our engineers in the coal industry in making quick calculations of pre-design costs of boiler and power plants, we are writing for permission to reproduce it in revised form for insertion in our "Fuel Engineering Handbook."

ROBERT T. SNURE
Associate Manager
Publications
Bituminous Coal Institute

• *We will be very happy to see Mr. Bishop's charts as part of BCI's valuable "Fuel Engineering Handbook."*

— *The Editors*

"There's the trouble with today's youngsters — they don't drill them enough in basic arithmetic."

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Circle 9422 opposite back cover.

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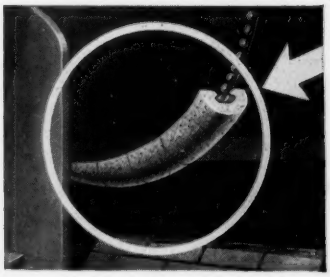

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No one can predict when the girth seam of a riveted HRT boiler will start leaking due to buckling of the outer lap. It's better to insulate the seam before the damage occurs, thus avoiding expense and hazard.

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National Boiler Protector Co.
928 Reibold Bldg., Dayton 2, Ohio

Circle 9423 opposite back cover.

MAY, 1960
VOLUME 2, NUMBER 5
Plant-Power Services Engineer

When did you last clean yours?

Here are some tips for cleaning air preheater tubes

A. JOHN, Assistant General Manager
Thomas C. Wilson, Inc., Long Island City, N.Y.

BOILER air preheaters of the tubular type are often expected to perform efficiently with scant attention to their proper maintenance. Because they are less in evidence than other types of tubular equipment, air preheaters may be neglected until they no longer function properly. But experience shows that air preheater tubes can be kept on the job with proper cleaning equipment and proper cleaning methods.

Fouling or plugging of air preheater tubes is likely to be most serious where coal or oil-fired installations are involved. Worst fouling usually occurs in the lower parts of the tubes, where outlet gases are the coolest. Complete plugging near the bottom, for distances of up to six feet, is not uncommon.

Most tubular air preheaters are vertical. The 2″ or 2½″ OD tubes are up to 30 feet in length, and usually in thin gauges. Topside design is such that only a limited amount of headroom is available. For this reason the drill-type cleaner, although more powerful, may be less applicable than the ordinary boiler tube cleaner.

The latter — consisting basically of motor, cutter, and hose — can be readily inserted into a tube even where the slanted heater roof comes to within two feet of the tube sheet. Headroom, however, will usually be more than this, perhaps four to six feet.

From our experience, we have found that accessories usually used with mechanical boiler tube cleaners are not always suitable for air preheater tube cleaning. The usual swing arm cutter heads and universal-jointed drill heads are not designed to clean solidly plugged tubes. On the other hand, carbide-tipped drill bits, attached directly to the motor rotor shaft by means of an adaptor, have been found to be effective in plugged or heavily scaled tubes. Bits selected should have a diameter 1/16″ or ⅛″ less than the inside diameter of the tubes.

This drill bit arrangement puts a heavy work load on the motor. Consequently, we recommend only powerful motors, preferably six-bladed vane-type air motors. Although designed for 90-125 psi air pressure, these motors cut cleaning time and aid chip removal when pressure is increased to 200 psi. The motor diameter should be ¼″ to ½″ less than the inside diameter of the tube to be cleaned.

This permits enough clearance for chips to pass upward beyond the motor, particularly when plugged tubes are involved. One pass usually cleans to bare metal. However, if residual deposits remain, a second pass can be made with a regular swing arm-type cutter head attached to the motor.

Whether air or water-driven equipment is used will depend largely on operator preference. Some operators prefer a water motor because the high pressure of the motor's exhaust jet and the rotating carbide bit make an effective cleaning combination. When normal 175 psi pressure is increased to 250 lbs, cleaning of plugged heaters can be speeded up. Water mixed with chips or cuttings tends to become slightly sulfuric, but this concentration is negligible in terms of exhaust rates of 30 gallons of water a minute. Nevertheless, a final fresh-water hosing down after cleaning is a good idea.

Air motors are more powerful than water, but they have the disadvantage of requiring use of respirators where no supplementary fresh air or exhaust system is available. Also, since dust mixed with perspiration may be toxic, skin areas should be protected from exposure.

The methods described above concern motors able to enter preheater tubes. Such motors are less powerful than those designed to remain outside the tubes. Where roof clearance is six feet or more, or where the roof can be removed, powerful drill-type cleaners can be used. The use of these powerful cleaners is likely to be more economical where the cleaning job is sizeable and the tubes are extensively plugged. Usually one pass does the job. If it does not, a small hole may be drilled during the first pass followed by use of the full-sized drill bit for subsequent passes.

A scavenger medium can be introduced at high pressure through the hollow rotating drill rods. Since the cutter bit shanks are also hollow and the bits have exhaust holes, the scavenger medium can push the chips ahead, at the same time keeping the bit cool. Where tubes are completely plugged, the scavenger forces the chips past the drill bit to topside for disposal. ■

Here's a space heating and cooling system that . . .

Produces and controls 301 'climates' in one building

One control center services the entire heating, air conditioning and ventilating systems at the California Division of Highways office building, which has 301 air conditioning zones. Secret to efficient zone control is the use of constant volume "mixing boxes" which supply tempered air to the individual zones. How this fine-controlled system operates is told in this article

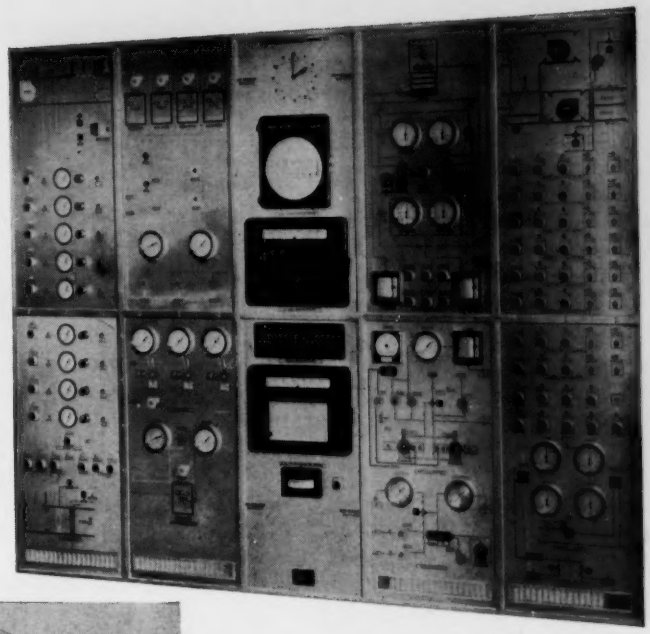
WHEN a building is broken up into offices and other areas, how do you design a space heating and cooling system so that each zone can have its own "climate"?

This was the problem facing engineers and designers at the California Division of Highways when they were planning the Division's new office building in Los Angeles, for the building — of Lift-Slab construction with tinted glass, curtain-wall skin — was to be divided into 301 air conditioning zones. However, the problem was easily met with an air handling system employing individual zone thermostats that can be supervised from one remote control point. The Division of Highways is very enthusiastic about the results it is getting with this design.

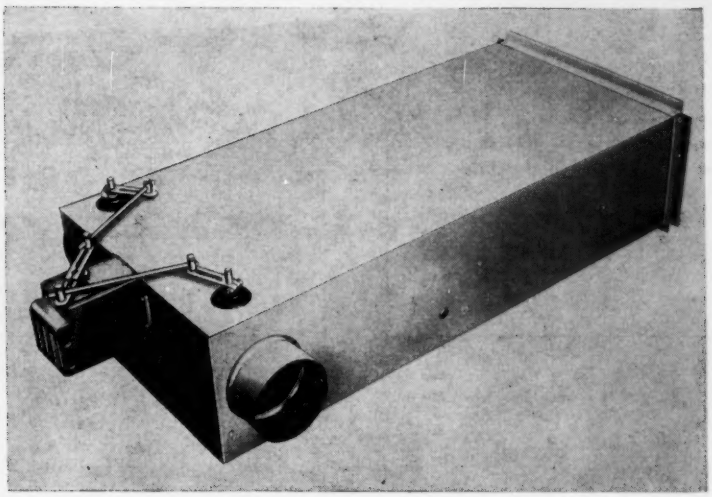
Big factor in the system is the use of constant-volume "mixing boxes", manufactured by Barber-Colman Co., to supply tempered air to each zone. These mixing boxes — one for each zone — maintain the required air volume regardless of static pressure changes within the specified limits. The boxes are designed to mix hot and cold high-velocity, high-pressure air and reduce it to conventional velocities and pressures. No power source is required for volume regulation — constant cfm delivery is maintained by an adjustable manual regulator within $\pm$ 5% for hot and cold inlet air pressure differences as high at 5:1.

Temperature control is a separate function. The thermostats adjust the damper position and control the flow of air through either the hot or cold side of the box to supply controlled-temperature air through ceiling diffusers.

The entire system for the new building — as well as the smaller existing office building — is controlled by a "Schematic" control center located in an office of the new building. All graphic illustrations depicting the many fan, refrigeration, heating and air conditioning systems are shown on the panel board. Thus, the control and remote operation of 14 separate mechanical equipment rooms is centralized in one location.



Entire heating and cooling system is supervised and controlled from this one panel. All components of the system are graphically presented and many operations are programmed to operate in correct sequence



Each zone in the 301-air-conditioning-zoned building is supplied with controlled-temperature air from a mixing box at a constant volume of air flow

Here are some of the features of the master control panel:

- Time switches automatically pilot the operation of the equipment in both buildings
- Supply fans of each system are started in sequence through a program switch to reduce starting load
- "Hand-Off-Auto" switches override the automatic control to start and stop any supply or exhaust fan or the refrigeration system, which includes chilled water pumps, condenser pump and cooling tower fan
- Pilot lights indicate operation of each of the above items and also all hot water pumps, oil pumps, boiler burners and all compressors
- Existing zone thermostats have been modified so that the control point can be remotely adjusted
- Hot and cold deck temperatures of the 8-fan systems can be remotely adjusted
- Electronic cold plenum controller proportions the return air, outside air and exhaust dampers in sequence with the chilled water valves, yet provisions have been made to override the cold plenum control should the outside air temperature rise above the predetermined setting. Switches in the control center also provide for an override of controls so that the dampers may be closed manually.

A multiswitch resistance bulb temperature indicator serves to check 35 various temperatures throughout the building, including all hot and cold plenum temperatures, space heating hot water supply and return, domestic hot water, drinking water supply and fan discharge temperatures of each fan system.

Relative humidity can be determined from the outside air wet-and-dry-bulb recorder. Boiler flue gas temperature is indicated on a "pyrometer." Flow conditions of the hot and chilled water, and condenser water are recorded in "gpm" on miniature strip chart recorders.

Pressure gages provide a constant visual check of operating pressures on the hot water supplies, boilers, and suction and discharge of compressors. The entire system is monitored by warning light and buzzer control to indicate immediately unsafe conditions should they occur at any point throughout the entire system.

Other features of the system include: smoke detectors located in all return air ducts, and roll-type, viscous-impingement filters on all fan systems with activated carbon filters on all outdoor intakes. This provision was made so that, during adverse atmospheric conditions, the outside air and exhaust air dampers could be closed and the remaining outside air would be filtered by the activated charcoal.

Cooling is supplied by two Trane 350-ton Centravac units, and two Cleaver-Brooks boilers are used for heating. The control center was built by Barber-Colman Co.

Circle 9424 opposite back cover.

Considerable savings have been realized at Pacific Northwest Alloys through the use of a simple device that . . .

Immediately shuts down compressor when mechanical malfunctions occur

How Malfunctions Can Occur — and How They Can Be Detected

In many instances, when a malfunction occurs in rotating or reciprocating equipment, the vibration is a low amplitude-high frequency "noise" which is clearly audible for several seconds or minutes prior to complete failure. An example of this is the vibration produced by a failing bearing. This vibration is of extremely small amplitude and not easily measured. Even so, the device described in this story will detect this small amount of excessive vibration and will sound an alarm or shut down the equipment to safeguard it against the possibility of serious damage. This device is not only sensitive to acceleration and displacement changes, but is also sensitive to vibratory velocity changes.

At least five times in the last three years, an important air compressor at Pacific Northwest Alloys, Inc., Spokane, Wash., has been saved from the possibility of serious damage. The "life saver" in each case has been a small device, called a "Vibraswitch", that detects excessive vibration occuring at any point in the compressor-driver train. When a very small vibratory malfunction occurs, this device, manufactured by Robertshaw-Fulton Controls Co., sounds an alarm and shuts down the compressor.

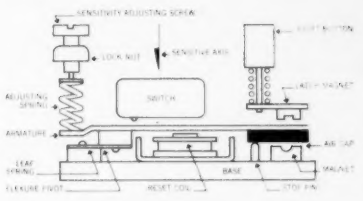
This two-cylinder, two-stage reciprocating air compressor, powered by a medium-speed (approximately 400 rpm) heavy-duty electric motor, is in almost-constant operation. Reliable performance is of vital concern, as it is the primary source of compressed air for the plant's operation — the manufacture of high-grade special steel alloys. Serious damage to the compressor would result not only in expensive repairs but in critical production losses as well.

Serious Damage Averted

Since installation in late 1956, the "Vibraswitch" has given the following protection:

On three occasions, equipment stoppages resulted from excess vibration caused by loose or broken bearing cap screws. In another instance, a broken bearing cap bolt caused an off-normal vibration condition, which was immediately detected. An additional situation was caused by a malfunction in the high-pressure-side valve-lifter assembly — a condition which if neglected would have developed rapidly into a serious equipment breakdown.

In each of these cases, the vibratory displacement resulting from the malfunctions was not substantial, but the high frequency-low amplitude acceleration that resulted was sensed by the "Vibraswitch" in time to cause shutdown before significant damage occurred. Plant engineers at Pacific Northwest Alloys feel that, if any of these malfunction conditions had been allowed to continue undetected for any length of time, costly repairs and serious plant shtudowns would certainly have resulted.



How It Works

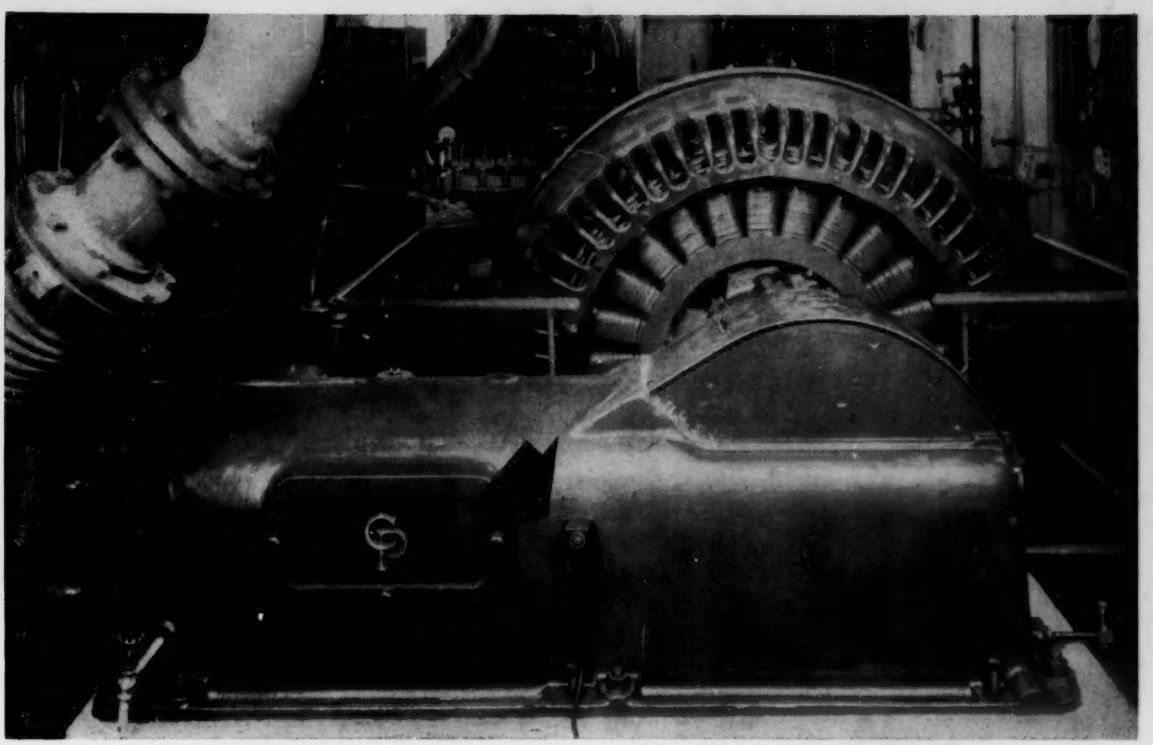
The "Vibraswitch" is a vibration-sensitive device that detects both low-frequency displacements and high-frequency accelerations — signs of malfunction in rotating and reciprocating machinery.

When the vibration of this equipment exceeds normal by a pre-selected amount, an internal switch closes, actuating either an audible warning system or a shutdown circuit.

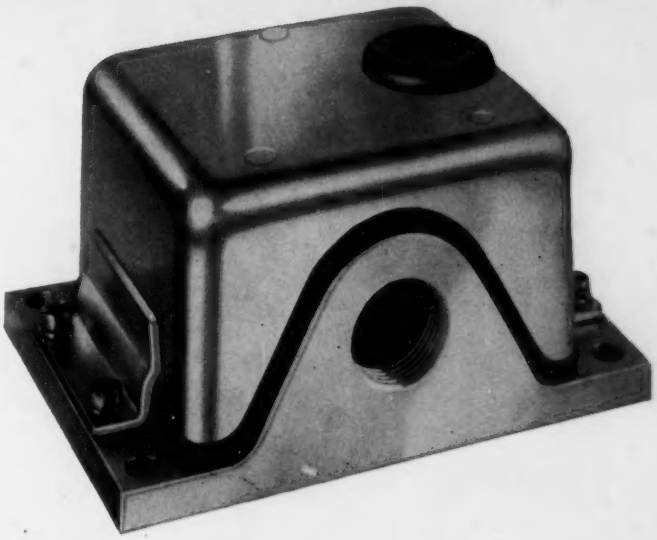
The sensitivity of the device increases with frequency, making it equally suitable for sensing either increases in amplitude at the operating speed, or high frequency chatter, noise, or shock associated with many types of malfunction.

Thus, complete protection is obtained, which is not available in devices which measure only shaft eccentricity or respond only to substantial amplitude changes.

The "Vibraswitch" employs a magnetic circuit opposed by inertial and adjustable spring forces in the actuating mechanism. (See drawing above.) The armature is constrained to only one type of movement by a frictionless flexure pivot composed



Five times in the past three years, a small vibration-detector (arrow) has saved this compressor from serious damage. In each case it has warned of excessive vibration caused by a mechanical malfunction and shut down the compressor before damage could occur



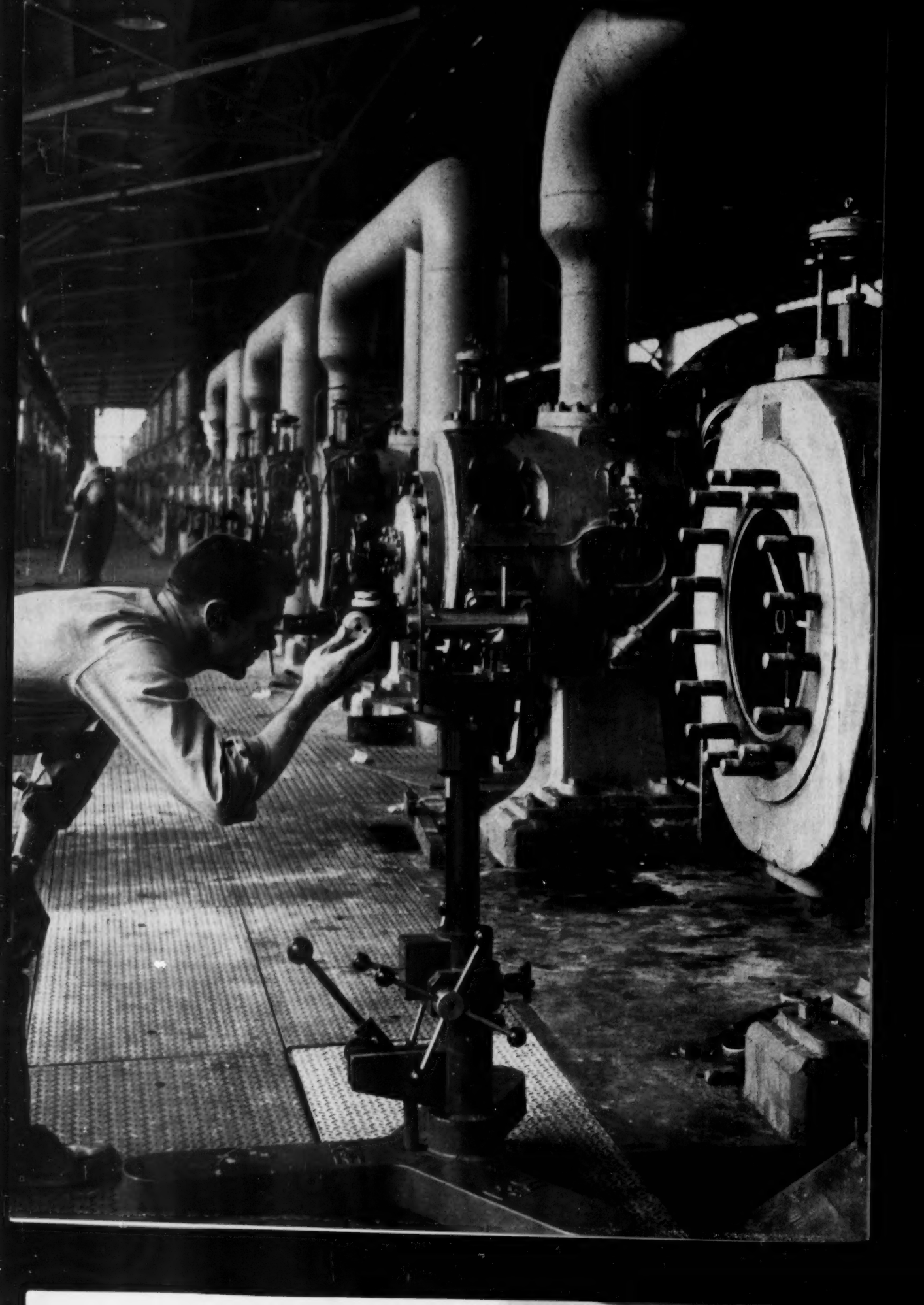
This is the newer model of the device that has been in service at Pacific Northwest Alloys. It offers the same low-cost protection from mechanical malfunction to virtually all types of rotating or reciprocating machinery

of two overlapping blocks and a leaf-spring, loaded in one direction to hold the blocks together. The armature rocks on the pivot, being forced in one direction by the adjusting spring and in the other direction by the magnet.

When the entire assembly is subjected to vibration perpendicular to the base, the peak acceleration times the effective mass of the armature produces an inertial force aided by the spring. When the peak exceeds a pre-selected level, the armature leaves the stop pin, and continues to move up until it strikes the magnet. During this upward travel, the switch is actuated to sound the alarm. The device may be reset by depressing the reset button or applying power to the electrical reset coil which also holds the armature in "normal" position during start-up. The adjustments for desired warning or shutdown level are easily made on an adjusting screw (which adjusts the spring tension). The exact amount must be determined from experience.

The sensitive axis of the switch is perpendicular to the mounting axis. Normally for machines with vertical or horizontal shafts, it is mounted in an upright position on a near vertical surface and is sensitive to the horizontal component of vibration. It may, however, be mounted in any orientation. Exact location is not critical, as the setting procedure automatically accounts for the normal or existing vibration.

Circle 9425 opposite back cover.



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OPTICAL VS "PIANO-WIRE" ALIGNMENT

Here's what Union Carbide Institute plant found in comparing two alignment methods:

1. Optical line of sight is far less susceptible to accidental dislocation
2. Line of sight can be established from any convenient location
3. Targets can be used to mark the center of bores
4. Optical mirror can be used to establish extremely accurate coaxial lines. With wire this had to be done with a physical square of limited dimensions

Result: a significant increase in speed and accuracy of alignment.

BETWEEN 60 and 65 large steam and motor driven compressors are in continual use at the Institute plant of Union Carbide Chemicals Company. Compressors are used for process gas, and for plant and process air. Bearing and shaft misalignment can be a continual problem in the operation and maintenance of these large machines.

Until early last year the plant had been using the conventional "piano-wire" system of alignment. Finally, however, it was decided to try optical alignment on a machine that had been a "trouble-maker" from the time it was first installed. This is a 1400-hp steam-driven air compressor, 2-stage, 30-inch stroke, with a capacity of 5840 cfm.

It was started up in 1950 and had been down six times, starting in 1951, with bearing trouble. When the machine had to be shut down again in March 1959, Keuffel & Esser optical equipment was used in a comparison test for alignment accuracy and downtime with the wire method on the same job.

Basic Problem

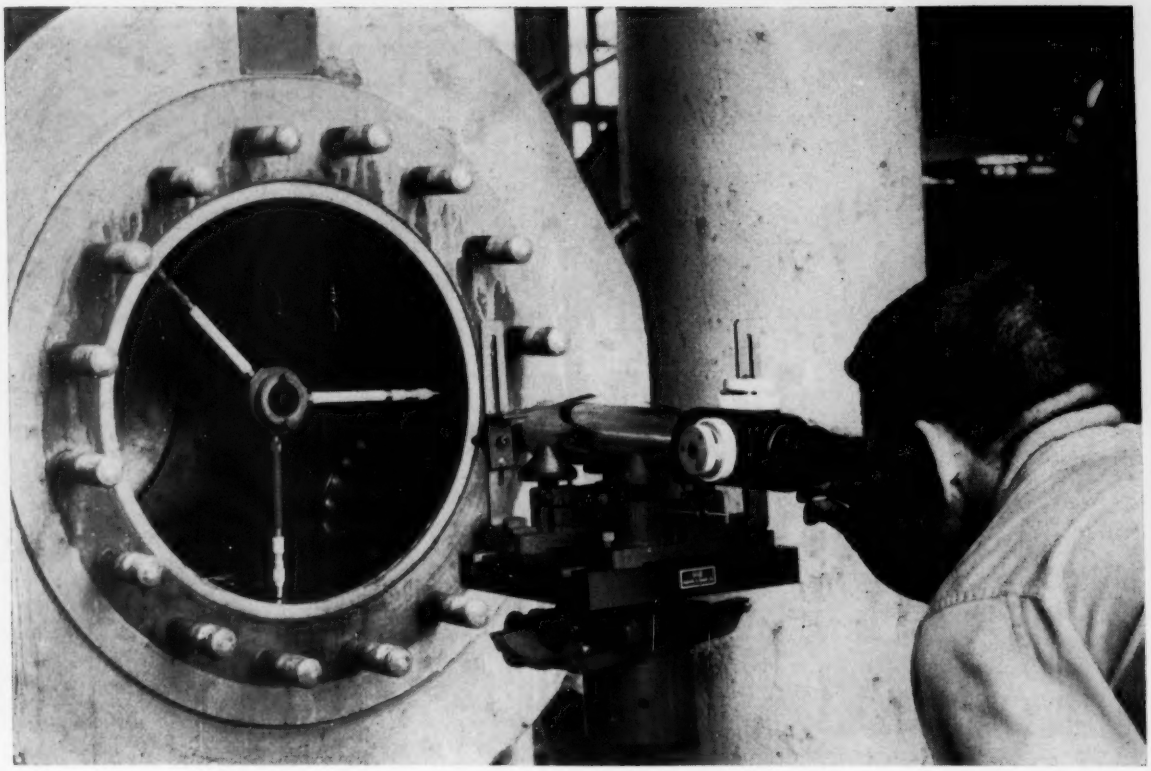
The basic alignment problem on the large compressor was the straightness of each of the two lines of cylinders and cross-head guides. This included possible lateral displacement and angular tilt between extended centerlines of the individual bores, as well as possible wear within each bore. It was also desirable to check the squareness of each of the cylinder centerlines with the main shaft centerline.

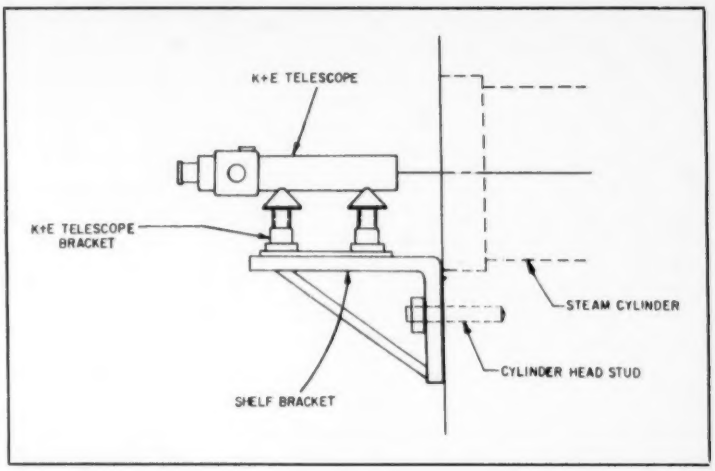
Being an "in-service" machine, it was important that the extent of mis-alignment of the unit be determined quickly. This data then needed to be evaluated to determine the method and extent of rework necessary to assure good operation in the future, and at the same time, allow for a minimum amount of downtime. In this case it was decided to rebore the cylinders and cross-head guides.

Establishing A Base-Line

Before a base-line could be established through the line of cylinders and cross-head guides, the decision had to be made whether the base-line should be independent of or part of the compressor itself. That is, should the telescope be mounted on an independent support

To next page





Where adjacent operating compressors cause floor or base vibration, telescope is mounted on bracket directly to cylinder face

From preceding page

or should it be fastened directly to the compressor. Since adjacent compressors had to be kept running in this case, it was necessary to isolate the base-line from the resulting vibration as much as possible. This was accomplished by mounting the telescope directly to the face of the cylinders. Furthermore, since the two steam cylinders were of the same diameter, the telescope was mounted at the steam end of the machine so that the same fixture could be used for each line of cylinders and guides.

A second decision had to be made on how to relate the base-line to the existing conditions. It was decided in this case to orient the base-line to that portion of the machine which was least likely to be misaligned. All other parts of the machine are then realigned to this base-line. The portion selected was the center portion which rests directly on the foundation. The cylinders all cantilever out from this center portion and are therefore subject to sag.

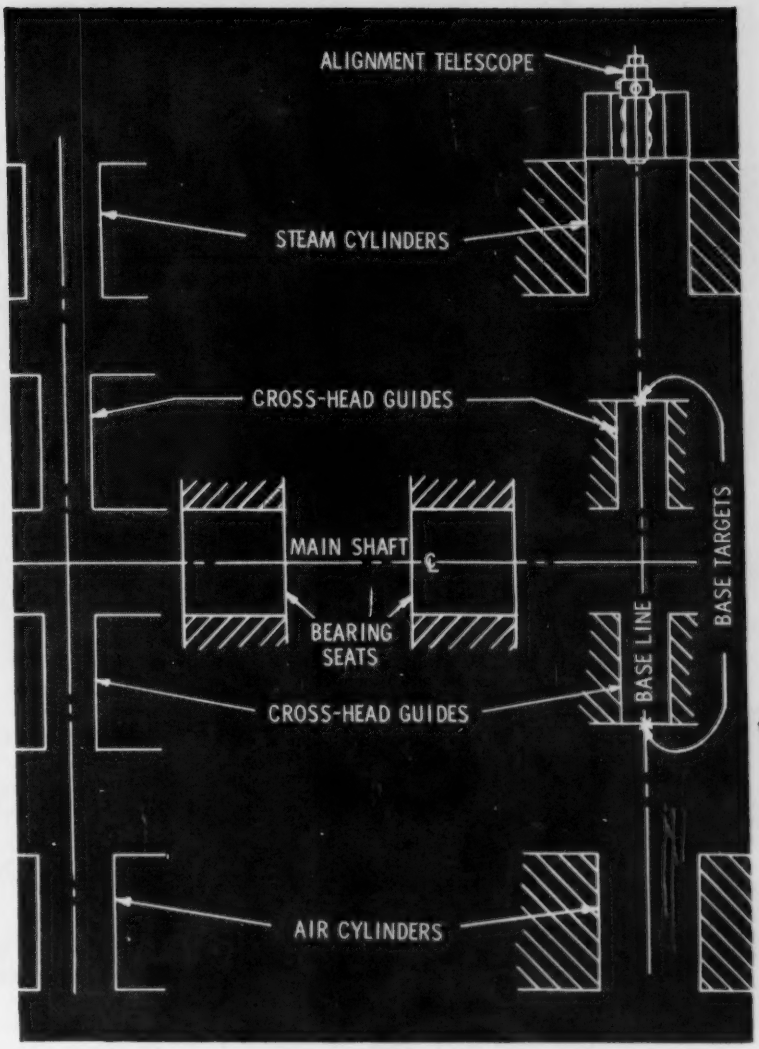
Optical Procedure

Two targets were centered, one in each of the two cross-head guides, at the edge of the bore farthest from the main shaft centerline. These two targets were used to establish the base-line, and were therefore left in position as base targets through-out the operation. The targets were held in place using a standard target holder and centered with a target centering device, an inside micrometer especially designed for this type of application.

The alignment telescope was then "bucked-in" or aligned to these two targets. This established the base-line, and the telescope was locked in position. The telescope was mounted on a standard bracket which in turn was supported on a shelf-bracket fastened to the face of the steam cylinder.

An additional target in a target

Targets are held in place with target holders and centered with either an especially designed inside micrometer centering device, or on larger bores, a sweep arm with dial indicator



In aligning large steam-driven air compressor, alignment telescope was mounted directly to face of cylinders. Because it rested directly on foundation and was least likely to be misaligned, center portion of cylinders was selected for the base-line

holder was then located successively at the center and then the inside edge of each of the crosshead guides. At each location, the target was centered to the line-of-sight of the telescope. The amount of misalignment was then read by "miking" from target to inside of guide. Six measurements were taken at each position.

A different type of adjustable target-holder was used in the cylinders because of the larger diameter. The centering device used with it is a sweep arm with dial indicator rather than an inside micrometer. With the cross-head guides, all measurements related directly to the base targets, since the same micrometer was used for all measurements. However, with the cylinders at each target location, the dial indicator was arbitrarily set at zero in the 12 o'clock position. Therefore, the 3, 6 and 9 o'clock readings related to the 12 o'clock reading at that target position only. Targets were set successively at the front, center and back of each cylinder bore, and where possible, in the counterbores. This completed the checking of one line of cylinders and cross-head guides.

The K & E alignment telescope was then removed from its bracket, without disturbing the bracket itself, and replaced with an alignment collimator. Because of the identical precision ground barrels and precise optical alignment of these two instruments, they can be interchanged and still maintain the same line of sight to within a very close tolerance.

An optical square was placed on the alignment telescope and the telescope and square were set in a bracket that had been located along the base line of sight approximately at the intersection of the main shaft centerline. Sighting through the "straight-through" objective window, the telescope and square were aligned to the collimator infinity target. Thus, the "straight-through" line of sight was set parallel to the original base line and the "right-angle" line of sight perpendicular to it. Then by sighting through the "right-angle" line to scales indexed against the vertical surfaces of the bearing seats, these surfaces could be checked for perpendicular with the main base-line.

This entire procedure was repeated on the other line of cylinders and guides.

After the cylinders and cross-head guides had been rebored, the compressor was put back in service. It has been operating perfectly for over a year with no knocks and no evidence whatever of mis-alignment. The optical method was found to be so much more satisfactory that the plant is now planning for its use on another large air compressor where mis-alignment has become a serious problem due to expansion and dirty steam.

The optical equipment has also been used in a pilot plant operation, for accurate alignment of spindles on a spindle machine for synthetic yarns.

Circle 9426 opposite back cover.

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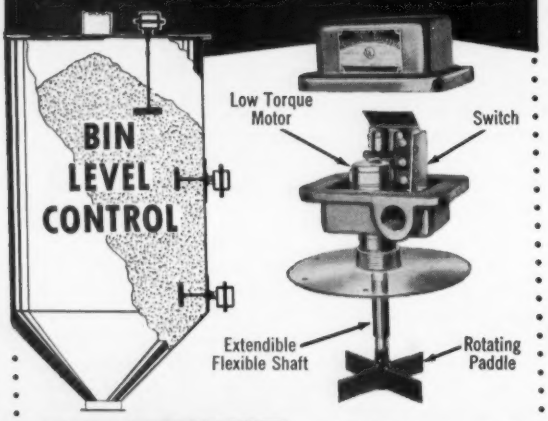

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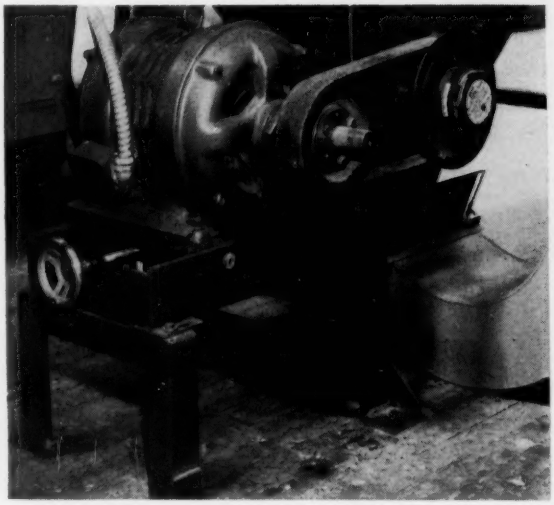
NEW SOLUTIONS
to your design and operation problems



With this variable-speed drive, cam pressure is exerted only when the load requires it. Driven speed is kept constant regardless of torque condition

Transmits power to eliminate stalling at slow speeds

Newly developed variable-speed drive does away with belt damage

Finding a variable-speed drive that would not stall at slow speeds presented a problem at the Richmond, Va., plant of Carrington & Michaux, Inc., processor of leaf tobacco. The drive was needed for a large (6000 lb/hr) tobacco shredder which operates 8 to 16 hr per day, 7 months a year.

The shredder is driven by a 20-hp motor operated at 1800 rpm. Most of the belt drives tested failed to transmit full motor capacity at the slower belt speeds. This would result in slippage, and the resulting frictional heat damaged the belt.

A newly developed drive was recommended. Called the "MCS" drive and manufactured by T. B. Wood's Sons Co., it efficiently solved the problem by maintaining constant belt speed and transmitting maximum belt capacity at slow speeds. This is possible because the variable-speed sheave is designed to hold constant-driven speed during changing torque loads.

The installation was made in this way: The variable-speed sheave was mounted on a countershaft, while the grooved companion sheave was installed on the motor. This method of mounting was possible because both flanges of the variable-speed sheave are movable. The sheave has a minimum pitch diameter of 6 inches and a maximum of 12 inches.

With this sheave, cam pressure is exerted only when the load requires it. Power is transmitted equally to both movable flanges through a series of torsionally re-

silient rubber cam followers. The sidewall pressure on the belt varies in proportion to the torque required. Since the grip on the belt increases as the load increases, the pitch diameter is maintained, and the driven speed is kept constant regardless of torque condition.

Belt life is prolonged because the flanges are not continually being squeezed against the belt by heavy thrust springs. Also, there is no fretting corrosion, freezing or sticking. The rubber cam followers are located outside the bearing surfaces. There are no points of constant contact between the flanges and sleeves to obstruct lubrication, and, with each revolution of the sheave, the oil film on the bearing surface is constantly renewed and evenly distributed.

Circle 9429 opposite back cover.

Steel belt lasts longer when handling coal

Other advantages are realized in furnace-feeding operation

Some 80 tons of coal per day is fed to three furnaces by means of a 35-ft long steel belt conveyor which should give its user, The Blackford Window Glass Co., Vincennes, Ind., at least three years of maintenance-free operation.

The steel belt, supplied by Sandvik Steel, Inc., is a strip or band of carbon steel especially trued and flattened at the mill for conveyor application.

At the plant, coal is delivered to the belt from a hopper and is discharged by a movable plow-type scraper to two of the three furnaces. Discharge to the third is over the terminal pulley.

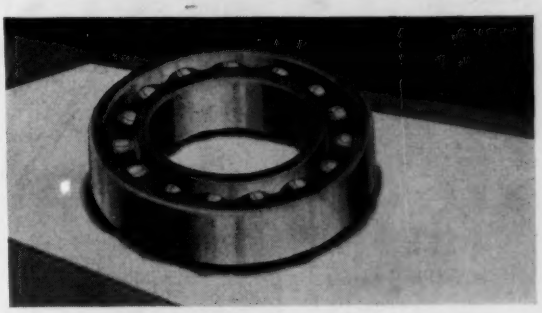
The discharge scraper travels on rails located on each side of the conveyor and is pushed from one furnace to the other as required. The scraper cannot damage or wear the belt by scraping particles from it, yet it contacts the belt with sufficient pressure that, for practical purposes, no dust passes beyond it.

The belt is 16 inches wide by 0.036 inches thick. Both the load and carrying strand and the return strand are supported on idler rollers. Belt speed is 15 ft/min.

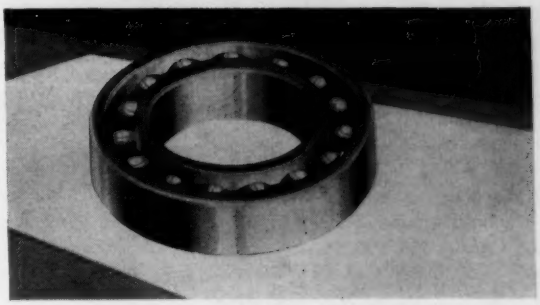
Circle 9430 opposite back cover.

Coal is delivered to steel belt from loading hopper (left) and is fed to furnaces by plow-type discharge (right) over sides of belt. Scraper cannot damage belt, and it makes contact with sufficient pressure to remove all dust

NON-FLUID OIL
TRADE MARK REGISTERED



Ordinary grease works out



NON-FLUID OIL stays in

Bearings last longer using NON-FLUID OIL

Ordinary greases, because of their nature, will work out of ball bearings — leaving finely polished balls and races without lubrication. Result: Excessive wear, speedy failure and costly shut-downs for repairs.

NON-FLUID OIL stays in bearings until entirely consumed, guarantees protective lubricant film at every point where metal-to-metal contact could set up friction. It contains nothing that can decompose and liberate fatty acids to damage bearings.

NON-FLUID OIL "stays alive" longer in bearings than ordinary grease and this fact has resulted in approval by most leading manufacturers of anti-friction bearings.

Write for free testing sample and Bulletin No. 506

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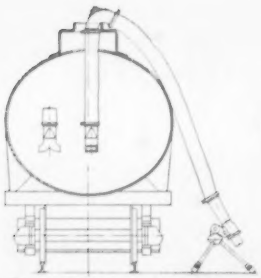
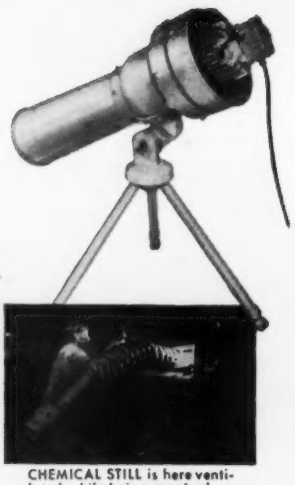
Also represented in principal industrial centers, including Pittsburgh, Pa., Cleveland and Cincinnati, Ohio.

NON-FLUID OIL is not the name of a general class of lubricants, but is a specific product of our manufacture. So called grease imitations of NON-FLUID OIL often prove dangerous and costly to use.

For more information, circle 9431 opposite back cover.



TANK CAR is easily freed of fumes for workers' safety.



CHEMICAL STILL is here ventilated while being repaired.

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For more information, circle 9432 opposite back cover.

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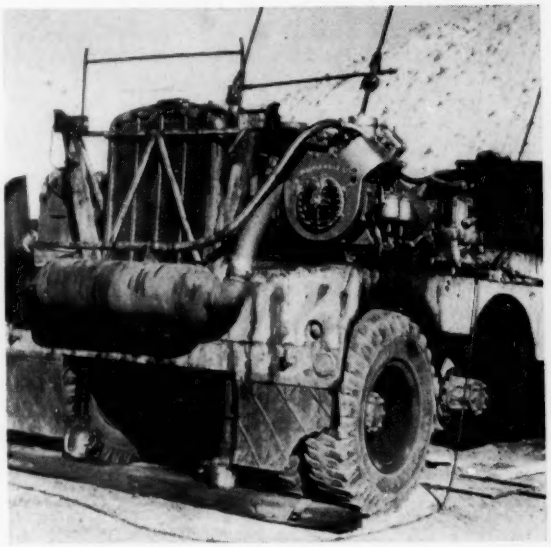


Small diesel generator set ties in with rest of mobile equipment to supply current for lighting during nighttime operations

Portable generator-set racks up savings

Has aluminum parts to make it lighter

In December, 1957, Richfield Oil Corporation placed into service in New Cuyama, Calif., a 5kw generator set. This diesel-powered unit, manufactured by American Marc, Inc., is on a rig which is used as a temporary derrick to pull all equipment from oil well holes for cleaning and repair. The generator supplies current to light the rig during nighttime operation.

A diesel was chosen for several reasons: First, all other equipment on the truck runs on diesel fuel, hence only one fuel supply is necessary. This particular diesel uses special-formula aluminum which makes it light, yet strong and durable. Third, there is no fear of explosion when starting up the unit in the presence of gases from the well.

Maintenance on the unit has been minimum. About every 400 or 500 hours of operation, the mechanics change the fuel filters and service the injectors. Other than that, nothing.

Circle 9434 opposite back cover.

For more information on items reported in the New Solutions section, circle corresponding numbers on reader service card opposite back cover.

NEW SOLUTIONS

to your plant
and equipment maintenance problems

Lets in natural light, cuts lighting bill

Plastic-panel skylights, windows eliminate need for artificial lighting on most days

Modern building materials are helping to solve one of industry's big problems—adequate in-plant lighting. The material is reinforced fiber-glass, translucent sheets of corrugated plastic for installation in places where natural illumination is needed for improved working conditions.

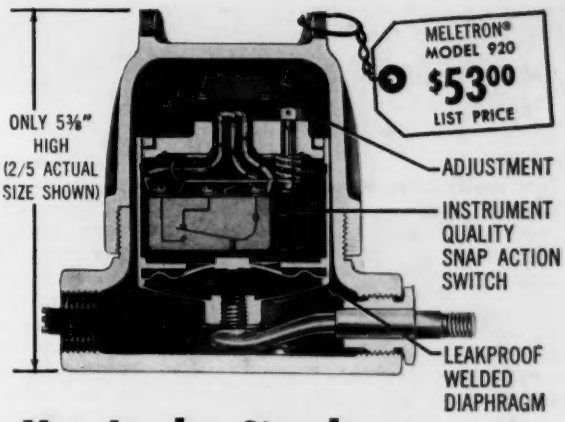
In recent improvements in the facilities of Independent Iron Works, Oakland, Calif., this shatterproof material was installed in skylights, monitors, and sliding-door windows in the fabricating and sand-blasting buildings.

The immediate result was greatly improved working conditions. The panels let in ample natural light, filtered of glare and ultraviolet rays. This illumination eliminates the need for artificial lighting on all but the darkest days, reducing the company's electric bill.

The skylights and monitors manufactured by Structoglas Inc. should require little maintenance for long, trouble-free service. Since they're shatterproof, no damage can result from vibrations of the large rolling doors, impact or vandalism. The panels are available in sheets 50 inches in width, minimizing the framing needed to support them.

Circle 9435 opposite back cover.

Glareless illumination from plastic panels eliminates need for artificial lighting on all but the darkest days



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EXTREME ACCURACY and DEPENDABILITY maintained during operating life due to direct acting design	LINKAGES & BEARINGS which, as they wear, make the setting of the pressure switch drift.
OPERATION IN ANY POSITION which saves the installation costs encountered in mounting a switch that uses liquid switching elements	LIQUID SWITCHING ELEMENTS which make the switch difficult to mount and very critical to vibration.
IMMUNITY TO VIBRATION you can mount the switch directly on your vibrating or moving equipment.	ACCORDION BELLOWS which make the pressure switch sensitive to vibration.

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PRESSURE SWITCH DIVISION

Barksdale valves

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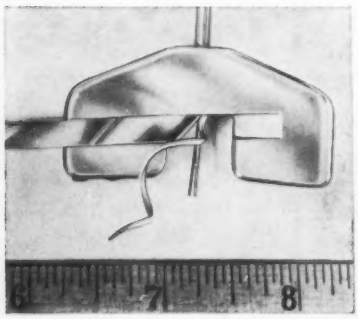
For more information, circle 9436 opposite back cover.

Tool easily skins sheathed thermocouple wire

Small, lightweight "skinner" removes sheath metal from thermocouple wire in a manner similar to, and as simple as, the action of a pencil sharpener. It is especially useful whenever thermocouple conductors must be exposed, as when attaching terminals.

Thermocouple wire to be skinned is inserted into the tool which is then rotated in a clockwise direction. A few twists and the metal sheathing is cut away cleanly.



Like sharpening a pencil

Open construction of the skinner provides two important advantages — the exact amount of metal sheath being skinned is always visible, and the cut pieces of sheathing fall out and away from the cutting area and therefore cannot clog or jam the tool.

Three sizes are available to accommodate 1/25", 1/16" and ⅛" OD thermocouple wire.

(Skinner is development of Thermo Electric Co., Inc., Dept. P&PSE, Saddle Brook, N.J.)

Circle 9437 opposite back cover.

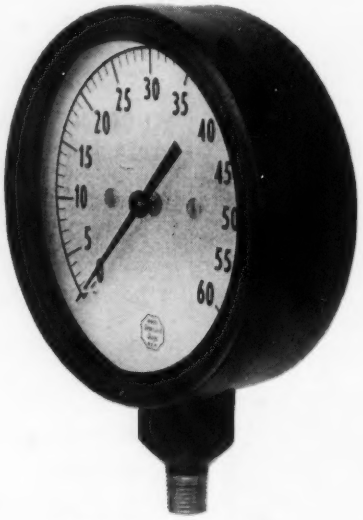
Heavy-duty pressure gage is multi-purpose

Geared-movement pressure gage has been designed for a wide range of heavy-duty industrial applications. It is recommended for oil, air, water, steam, gas or any other media not corrosive to brass or bronze.

Integral design of the socket, tube, tip, movement, pointer and dial assembly permits installation by hand-turning the gage case and eliminates inaccuracies in pressure readings resulting from any distortion of piping. Rugged, dependable service is assured by utilization of a heavy-drawn steel case, a friction type snap-on ring that is beaded for lens protection.

Long wear and consistent accuracy are assured by the use of bronze-bushed pinion and segment shafts, nickel silver pinions, and stainless steel hairsprings. Precision machine-cut geared-type movements are mounted directly to socket shank to eliminate distortion.

Featuring heavy-duty glass, shatterproof or plastic being optional, both sides are protected against shock by two weather-resistant gaskets. Gage's 4½-inch dial, with its white background and black



Gives long-time accuracy

lithographed figures for utmost readability, is mounted directly on the movement.

Made in 20 different standard compound and vacuum ranges, stocked for immediate shipment, it can be connected into pressure line through a ¼" N.P.T. bottom connection.

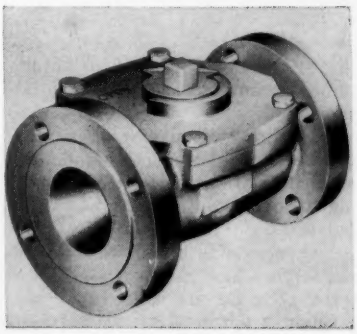
(Heavy-duty gage is a development of Helicoid Gage Division, American Chain & Cable Company, Inc., Dept. P&PSE, 929 Connecticut Avenue, Bridgeport 2, Conn.)

Circle 9438 opposite back cover.

Ball valves are designed to absorb high loading

Line of ball valves features a ball which rotates on a fixed axis between bearings that require no lubrication, and which can absorb tremendous impacts and loading without back-lash or danger of distortion.

Design makes it possible to disassemble and service the valve



Available in sizes 1 to 10 inches

without removing it from the line. When four bolts are removed from the top flange, it can be lifted off, giving ready access to three removable parts, which are the two seats and the ball. Requiring no special tools or adjustments, the whole assembly goes together as easily as it comes apart.

Valves also feature 100% flow efficiency, two-way flow, zero leakage and low torque manual operation. They are available in sizes 1 to 10 inches for off-the-shelf delivery to industrial users. Operating range is from −20°F to 400°F and pressures from vacuum to 300 psi. Materials include semi-steel, type 316 stainless, carbon steel, and aluminum.

(Flo-ball valves are development of Hydromatics, Inc., Dept. P&PSE, 70 Okner Parkway, Livingston, N.J.)

Circle 9439 opposite back cover.

For more information on items reported in the New Developments section, circle corresponding numbers on reader service card opposite inside back cover.

Offer fluorescent safety paint in plant-test kits

"Do-it-yourself" plant-test kits enable safety and maintenance men to compare for themselves the safety advantages of fluorescent colors versus the brightest regular safety colors. Fluorescent colors are said to be up to 4 times brighter than the brightest non-fluorescent safety paint now available.

Kit No. S-3 is designed for spray application and holds three 16-oz aerosol cans containing white primer, fluorescent color and sealer. Kit No. S-20 offers these three items plus ¼ pints of all 8 fluorescent colors in alkyd enamel, white primer and protective sealer.

High visibility fluorescent safety paint can be applied on fire protection apparatus, lift-trucks, dangerous parts of machinery, elevator doors, low beams, pipe coding, emergency stop buttons and many other areas where it reduces accident potential.

(Safety paint kits are product of Lawter Chemicals, Inc., Dept. P&PSE, 3550 Touhy Avenue, Chicago 45, Illinois.)

Circle 9440 opposite back cover.

Steam trap discharges continuously

Steam trap as only one mechanical moving part: a simple trunnion rotating valve unit, which controls the flow of condensate.

Accumulation of condensate above the normal operating level activates the float. Float pivots on the stainless steel trunnion valve assembly and permits continuous discharge of the condensate. Development is said to eliminate pounding of valves and wearing of springs, levers, or links, and rupturing of bellows. Condensate is discharged gradually and continuously according to load, with smooth shock-free flow.

Traps are available in sizes from ½ to 2 inches, for pressures of 35, 100, 150, 200, 400, 600, and 1000 psi.

(Steam trap is a development of Rifox U.S.A., Inc., Dept. P&PSE, 26 Journal Square, Jersey City, N.J.)

Circle 9441 opposite back cover.

Here's why you're money ahead

with A. O. Smith glass-protected smokestacks

- Now available in a variety of colors
- They last longer — as much as 3 to 5 times longer than unlined steel stacks — corrosion resistant regardless of excess condensate
- Glass is tough, durable — shows remarkable resistance to impact or abrasion
- Maintenance is low! There's no painting—glass can't rust
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PROCESS EQUIPMENT DIVISION
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For more information, circle 9442 opposite back cover.

Portable Pyrometer Indicator Does Many Jobs

MINIMITE®

Null Balance, Potentiometer Type

The "MiniMite" Portable Potentiometer Indicator gives you laboratory accuracy in a rugged, versatile instrument. Use it conveniently for a wide range of temperature measurement, calibration and test purposes. Its dimensions are only 4" x 5" x 6"—weight is under 4 lbs. Accuracy is ¼ of 1% of scale range.

Temperature Measurement For direct temperature measurement, connect the "MiniMite" to a thermocouple. It's ideal for laboratory work, emergency operation or substitution for instruments under repair... also for many types of research and test work.

Calibration Use the "MiniMite" with equal facility for calibrating thermocouples, or both potentiometer and millivoltmeter-type instruments.

Scale Range Individual ranges on the "MiniMite's" double-range scale are almost 24" long. Choose from 49 different range combinations to cover temperatures from −300°F. to +3200°F. for all standard thermocouples, and millivolts from −6.2 to +62.

Write For Bulletin 64-20

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For more information, circle 9443 opposite back cover.

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VIBRATION INDUCERS

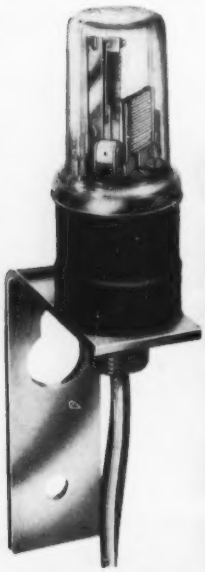
*VIBROLATOR CCVP-3000, the 6600-lb. impact vibrator — or one of its three smaller brothers — IS GUARANTEED TO DO YOUR JOB OR YOUR MONEY BACK.

Order from your distributor today, or write for complete catalog.

MARTIN ENGINEERING COMPANY
Largest Producer of Rotary Vibrators
123 Powers Street, Neponset, Illinois

® VIBROLATOR is Martin Engineering's registered trade mark for vibration inducers and vibrator accessories.

For more information, circle 9444 opposite back cover.



CUT YOUR LIGHTING COSTS
TURN LIGHTS ON AT DUSK-
OFF AT DAWN
AUTOMATICALLY!

There are over 250,000 Precision Photo Controls regulating yard, platform & other outdoor lights, producing artificial light only when necessary.

PRECISION MULTIPLE CONTROLS., RIDGEWOOD, N.J.

For more information, circle 9445 opposite back cover.

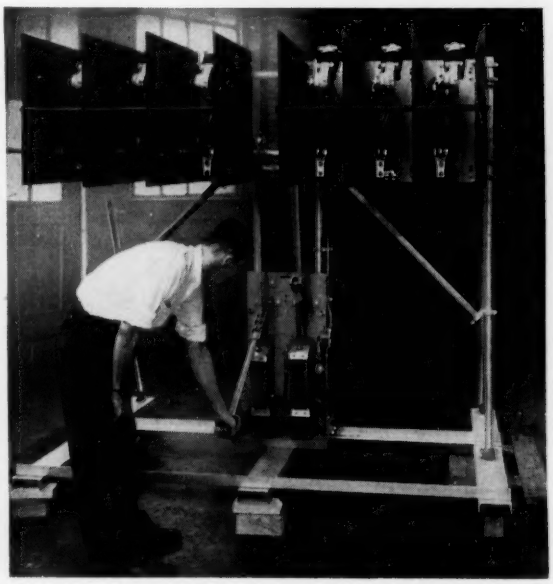
Automatic transfer mechanism assures continuous power

When power fails, unit switches to emergency power supply

Activated by stored energy, a dual-cylinder, double-throw automatic switch transfer mechanism is specially designed for installation in an area encompassing hospitals, freezer storage plants and other power users for whom an extended service interruption could be disastrous.

When power failure occurs, the mechanism opens the preferred source disconnect switch and closes another to transfer instantly to an emergency power source. The cylinder for the preferred switch is activated by loss of preferred-source voltage.

A timing device selects from 0 to 30 seconds time delay to allow circuit breakers to operate properly before triggering the preferred cylinder.



Timing device selects from 0 to 30 seconds delay to allow circuit breakers to operate properly

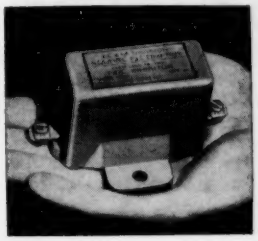
When the preferred switch is opened, a signal is immediately relayed to the second cylinder to close the emergency switch and cut in the emergency power source without interruption of service. The mechanism offers selectivity so the preferred line may be designated as either of two sources.

The two three-phase switches are equipped with compact enclosed-type interrupters and have insulating barriers between the phases.

(Automatic switch transfer mechanism is product of H. K. Porter Company, Inc., Delta-Star Electric Division, Dept. P&PSE, 2437 Fulton St., Chicago 12, Ill.)

Circle 9446 opposite back cover.

Arc inhibitor . . .



. . . increases the service life of control circuit contacts as much as ten times.

For use with DC crane and mill controllers operated by master switches or pendant push button stations, arc inhibitor both suppresses arcs and absorbs voltage surges to keep voltage rise within safe limits. Arc inhibitors eliminate the need for heavy-duty pilot devices, reduce contactor drop-put time up to 70%.

Units are recommended for 115 and 235 volt DC inductive circuits and are easily connected in parallel across the coil terminals of magnetic contactors. Vital components are embedded in an epoxy resin compound for protection against dust and moisture.

(Arc inhibitors are product of Square D Company, EC&M Division, Dept. P&PSE, 4500 Lee Road, Cleveland 28, Ohio.)

Circle 9447 opposite back cover.

Industrial fans have wide applications

Line of industrial fans includes fans which are available in three blade shapes, a wide range of wheel and inlet sizes and five arrangements, is designed to meet most industrial requirements.

Air and gas fumes handling wheels in the fan line have backwardly-inclined blades for top efficiency. For pneumatic conveyor systems, a granular materials handling wheel is available with straight blades. To permit easy movement of stringy or fibrous materials such as found in textile and woodworking mills, a straight wheel without a side plate is available.

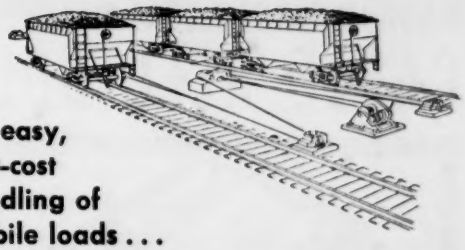
Fan wheels are electronically balanced and fan shafts are machined to close tolerances. Heavy-duty ball bearings are standard in the line for long life under rugged operating conditions. Housings are sturdy steel construction with horizontal and vertical reinforcement. Access doors speed cleaning and reduce maintenance costs.

Fans come in all AMCA standard wheel sizes from 19⅛ to 64⅜ inches with 11 inlet sizes from 11 to 37 inches. All fans have AMCA certified ratings.

(Industrial fans are development of The Trane Company, Dept. P&PSE, La Crosse, Wis.)

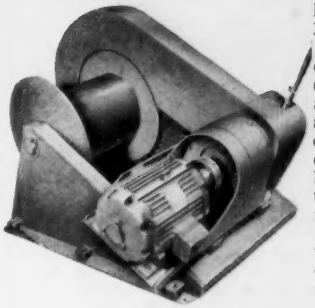
Circle 9448 opposite back cover.

For more information on items reported in the New Developments section, circle corresponding numbers on reader service card opposite back cover.



For easy, low-cost handling of mobile loads . . .

LINK-BELT *DRUM-TYPE* CAR PULLERS



Powerful enough to move 20 loaded freight cars (1000 tons), Link-Belt car pullers bring ease and economy to heavy haulage jobs. They're ideal for a wide variety of applications . . . moving freight cars and barges, dragging loaded skids, pulling materials in and out of furnaces, kilns, ovens.

Available *from stock* with single or double drums . . . in many types and capacities.

SEND FOR NEW BOOK 2892

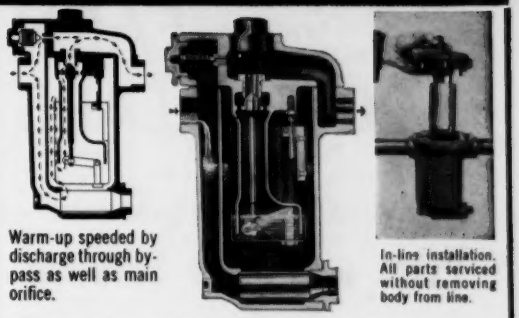
LINK-BELT

CAR PULLERS AND CAR SPOTTERS

LINK-BELT COMPANY: Prudential Plaza, Chicago 1, Ill. 15,238

For more information, circle 9449 opposite back cover.

Now—A Steam Trap that Adjusts Automatically to Every Operating Condition!



Warm-up speeded by discharge through by-pass as well as main orifice.

In-line installation. All parts serviced without removing body from line.

AUTOMATICALLY REGULATES FOR FASTER WARM-UP AND TO KEEP OPERATING TEMPERATURE AT PEAK HEAT

Proven bucket design with built-in accessories. By-pass thermostat increases discharge for warm-up and overload conditions. Thermostat compensated to operate at 10° below saturated steam temp. Wright-Austin Airxpel principle provides for mechanical discharge of air after Thermostatic by-pass has closed.

WRITE FOR BULLETIN 808

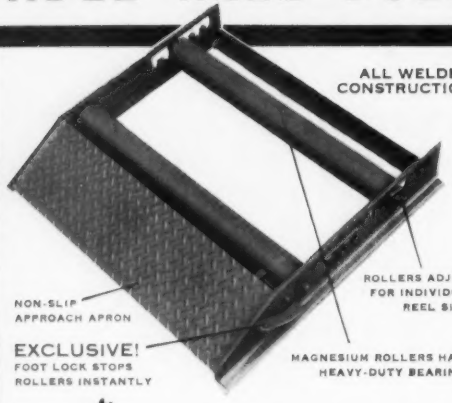
WRIGHT-AUSTIN COMPANY

3245 WIGHT STREET • DETROIT 7, MICH.

For more information, circle 9450 opposite back cover.

MAGCOA LIGHTWEIGHT MAGNESIUM

CABLE REEL DOLLY


ALL WELDED CONSTRUCTION
ROLLERS ADJUST FOR INDIVIDUAL REEL SIZES
NON-SLIP APPROACH APRON
EXCLUSIVE! FOOT LOCK STOPS ROLLERS INSTANTLY
MAGNESIUM ROLLERS HAVE HEAVY-DUTY BEARINGS

Only 33 pounds of magnesium does the job of 70 pounds of steel . . . the Magcoa Cable Reel Dolly handles reels up to 30" wide, weights up to 2,000 lbs. Use two dollies side-by-side for larger reels.

ONLY $49.50 F.O.B.

MAGNESIUM COMPANY OF AMERICA

155 S. E. 10th AVENUE/HIALEAH, FLORIDA

For more information, circle 9451 opposite back cover.

YOU CAN EARN 20 DOLLARS

BY HAVING A NOMOGRAPH IN

Plant and Power Services Engineer

PLANT and POWER SERVICES ENGINEER is looking for good nomographs designed to simplify calculations necessary to efficient plant and power services. If you have such a nomograph that has been helpful to you in your work — and it has not been published before — send it to:

Data Editor
PLANT and POWER SERVICES ENGINEER
111 E. Delaware Place
Chicago 11, Illinois

NEW DEVELOPMENTS

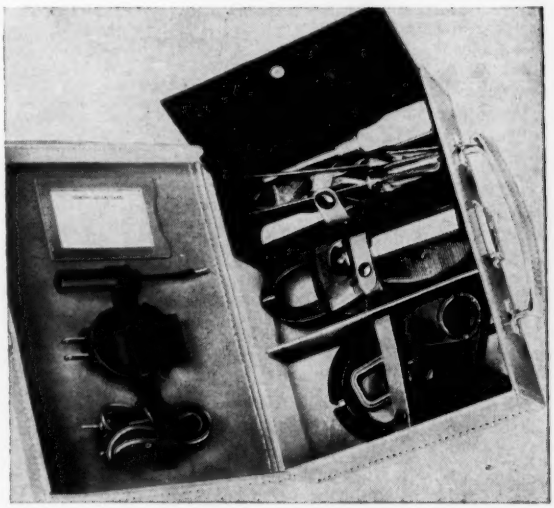
for effective plant and equipment maintenance

Everything for electric test in one handy kit

Contains volt-ammeter, accessories and small handtools

Designed to hold a volt-ammeter and accessories in one compact case, kit measures 7½" x 10" x 2½", yet has interior space for not only test instruments but small handtools that are used most often by electricians.

Available in two models, the kit is designed for use by all electrical men: contractors, plant maintenance, refrigeration, air conditioning and oil heating.



Kit contains "snap-around" volt-ammeter and accessories as well as tools used most often by electricians

One model contains a "snap-around" volt-ammeter-ohm meter with five current ranges and three volt ranges. In addition, it holds a device that extends amperage readings 10 times, as high as 1200 amps, and another unit which multiplies the sensitivity of the instrument 10 times for readings on small appliances and fractional horsepower motors.

The other model contains a lower-cost "snap-around" volt-ammeter.

(Test-Master kit is product of Pyramid Instrument Corporation, Dept. P&PSE, 630 Merrick Rd., Lynbrook, L.I., N.Y.)

Circle 9452 opposite back cover.

NEW LITERATURE *for effective design and operation*

Reviews of books and industrial bulletins describing equipment, supplies and services

Does your plant need more light, air?

Containing installation drawings, dimensions, dome and electrical specifications, 8-page Bulletin 60 LV gives full details on "Astro-Lites" (skylights) and "Astro-Vents" (ventilated skylights) designed for heavy-duty commercial, institutional and industrial requirements. Skylights feature one-piece acrylic resin dome and are offered in square or rectangular shapes in lengths from 14 to 115 inches. Vented units are available with air moving capacities up to 4400 cfm. Jenn-Air Products Co., Inc.

Circle 9453 opposite back cover.

Ductile iron pipe and fittings

Help in solving pipe corrosion problems is offered in 22-page book covering ductile iron pipe and fittings. It contains tables which set forth the physical and metallurgical properties of ductile iron pipe, and compares its corrosion resistance in various media. It gives specifications of pipe and fittings with flanged joint, "bell-tite" joint, and with plain or threaded ends. James B. Clow & Sons, Inc.

Circle 9454 opposite back cover.

How to lick corrosion in condensate return

Drastic reduction of return line corrosion in an easy, effective and economical way is described in Bulletin CP100. Amine treatment is the process discussed. The Bird-Archer Co.

Circle 9455 opposite back cover.

Rotameters and flow indicators

Rotameters and flow indicators Bulletin M-1 describes the following products: general-purpose glasstube types, armored types for measuring fluids or fluids under abnormally high pressures, bypass and "T" types of measuring large flows, transmitting types for the remote indicating, recording, or controlling of fluid rate of flow, laboratory and chemical types, alarm types, and small purge units for applications where inexpensive types are needed to indicate and manually control small flows. Schutte and Koerting Co., Instrument Division.

Circle 9456 opposite back cover.

Diaphragm pressure switch for explosive atmospheres

Simplicity of diaphragm pressure switch for explosive locations is described in Catalog 9-PS. The switch can be mounted directly on vibrating equipment, and it uses no linkages, bearings or liquid switching elements. Barksdale Valves.

Circle 9457 opposite back cover.

You can carry around this pyrometer

Portable pyrometer indicator measures only 4″x5″x6″ and weighs under 4 lb. It is ideal for handling many temperature measurement, calibration or test jobs around the plant. Bulletin 64-20 describes 49 different range combinations to cover temperatures from −300°F to +3200°F for all standard thermocouples. Thermo Electric Co., Inc.

Circle 9458 opposite back cover.

Sprockets and chains — large selection shown

An extensive line of roller chain and sprockets is detailed and illustrated in 56-page Bulletin A691. Complete with selection data, the bulletin also includes general information on the installation of roller chain drives, calculation of center distances, horsepower ratings, conveyor engineering, and instructions for lubrication and maintenance. Expanded line of roller chain includes single-strand, double-strand, single-strand heavy series, double-pitch drive, double-pitch conveyor, double-pitch conveyor with large rollers, and standard attachments. Dodge Manufacturing Corp.

Circle 9459 opposite back cover.

Magnetic pulleys bulletin

Erium-powered permanent magnetic pulleys are featured in 6-page bulletin. Pulleys remove tramp iron and small iron contamination, preventing machinery damage, fires, and explosions. Eriez Mfg. Co.

Circle 9460 opposite back cover.

Gasoline-driven electric plants

Gasoline-engine-driven electric generating plants are described in 4-page Folder F-145. A chart of representative models within each specific series lists such details as capacity of the plant, voltage, type of engine, starting method, dimensions and weights. Air-cooled models range from 500 to 10,000 watts; water-cooled units from 10,000 to 170,000 watts. D. W. Onan & Sons, Inc.

Circle 9461 opposite back cover.

Double-seal ball valves

Pictorial brochure gives rundown of product data sheets for industrial personnel who desire further detailed information on any given valve type or accessory item for double-seal ball valves. Jamesbury Corp.

Circle 9462 opposite back cover.

Flexible connectors

Flexible metallic connectors developed for use on pump installations, hot water systems and steam systems where thermal expansion and vibration are problems are described in 2-page catalog. Pennsylvania Flexible Metallic Tubing.

Circle 9463 opposite back cover.

Split-case centrifugal pumps for smooth performance

Two bulletins describe horizontally split, single-stage, double-suction and horizontally split, two-stage, opposed-suction centrifugal pumps in capacities to 6000 gpm, with heads to 600 ft. Design gives streamlined liquid flow for all types of water and general service. Aurora Pump Division.

Circle 9464 opposite back cover.

When you want clean air

Twelve-page Bulletin 405 contains complete information on a high-velocity electronic air cleaner that features up to 95 percent efficiency in removing smoke and airborne dust and pollen from all types of ventilating systems. The cleaner features unit construction and is available in six models, either field assembled or in cabinet unit form. Dollinger Corp.

Circle 9465 opposite back cover.

RETURN LINE CORROSION *Can* BE LICKED!

Drastic reduction of return line corrosion in an easy, effective and economical way has been the unanimous experience of hundreds of plants throughout the country using Bird-Archer's Amine Treatment.

A plant in New York State, generating approximately 500,000 lb. of steam a day, had a normal condensate pH value of 6.3 that resulted in almost constant piping replacements. Only 6 lb. per day of Bird-Archer's Amine Treatment cut maintenance costs to a new low by raising the pH value to the safe range of 8.0 to 8.5.

A plant in New England, generating 600,000 lb. of steam a day, did not have an open feedwater heater which would mechanically eliminate the exceedingly high CO_2 content of their makeup water, consequently, the pH value of their condensate was sometimes as low as 5.9. Less than 12 lb. of Amine Treatment a day raises the pH value of the condensate to 8.5, eliminates excessive corrosion.

After two years of experience with Amine Treatment a power plant in Massachusetts, making 250,000 lb. of steam a day, enthusiastically reports that they eliminate over 75% of their piping replacements through the use of only 2 or 3 lb. a day of Amine Treatment.

Return line corrosion has been licked at these plants. Let a Bird-Archer Service Engineer help you solve *your* corrosion problems.

Write for Bulletin CP100 and the name of the Bird-Archer Service Engineer nearest you.

BA-803

BIRD-ARCHER
WATER TREATING CONSULTANTS
The BIRD-ARCHER Company, 4337 N. American St., Phila. 40, Pa.
New York • Chicago
The BIRD-ARCHER Co. of California, 415 Brannan St., San Francisco
Offices in Canada and Mexico

For more information, circle 9466 opposite back cover.

NEW LITERATURE

When you want to move large mobile loads

For easy, low-cost handling of coal cars, drum-type car pullers are powerful enough to move 20 loaded freight cars. Or they can be used to pull materials in and out of furnaces and kilns. Single or double drum types—in complete range of types and sizes—are described in Book 2892. Link-Belt Company.

Circle 9467 opposite back cover.

Diesel-electric plants for portable, other use

Series of diesel-engine-powered electric plants is featured in 8-page booklet. The 2000-, 5000- and 7500-watt plants are engineered for the construction, railroad and industrial markets. The engine's direct injection combustion system provides fuel economy and assures quick, cold-weather starting. Kohler Co.

Circle 9468 opposite back cover.

Comprehensive bulletin on centralized lubrication

Revised general Bulletin 26-T contains information on complete line of centralized systems of lubrication, together with a discussion on principles of operation and description of system components. Eaton Manufacturing Co., Farval Division.

Circle 9469 opposite back cover.

Reducers, gear-motors featured in bulletin

Eight-page Bulletin No. 198 describes and illustrates basic and modified types — as well as mounting positions — of line of "Slo-Speed" gear-motors and separate speed reducers. Sterling Electric Motors, Inc.

Circle 9470 opposite back cover.

All about sludge collectors

Complete line of six series and fifteen types of sludge collectors for water, sewage and industrial waste treatment settling tanks is described with detailed drawings and data in 28-page Book 2546. Two new series are presented. One features multiple effluent weirs for uniform flow and a tank with sloping bottom for construction economies. The other consists of aeration sludge collectors for preliminary and extended pre-aeration and settling. Link-Belt Company.

Circle 9471 opposite back cover.

Nomographic determination of pipeline sizes

SYLVESTER SALVA
Jackson, Michigan

This nomograph enables one to determine easily internal pipe diameters in inches when the capacity and velocity are known. It is derived from the equation:

$$D = \sqrt{\frac{Q}{2.448V}}$$

where

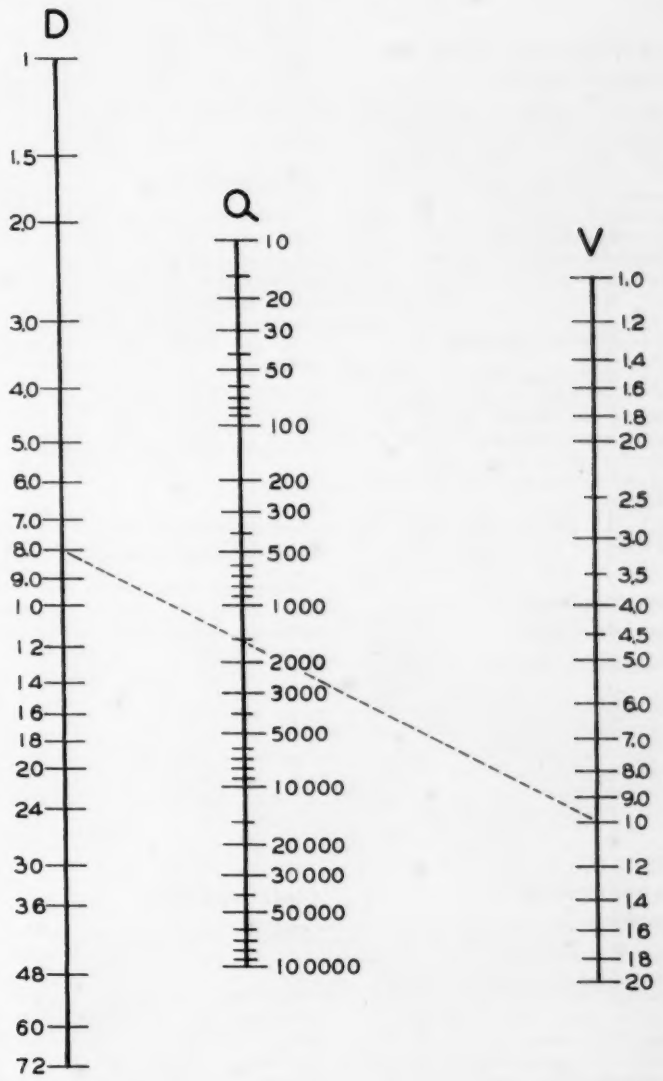
D = internal diameter, inches
Q = capacity, gpm
V = velocity, ft/sec

When determining the ID of pipes, attention should be given to the fact that the capacity of water piping will decrease with age due to tuberculation; therefore, provisions for future growth should be provided. In designing a water piping system, two factors have to be considered: flow and velocity.

Typical Example

Compute the ID of a pipe needed to deliver 1500 gpm with a velocity of 10 ft/sec.

A line drawn from 10 on the V scale to 1500 on the Q scale and extended to the D scale will give the answer as 8 inches on this scale.



© Putman Publishing Co. 1960

For heavy-duty pumping of abrasive fluids

Five sizes of heavy-duty, solids-handling pumps with capacity range up to 9500 gpm and for heads up to 220 ft are featured in Bulletin No. 725.5. Pumps are of the end-suction, vertically split type, featuring back pullout assembly which gives ready accessibility to all rotating parts without disturbing pipe connections. All pumps have 45° self-venting discharge connections as standard. Goulds Pumps, Inc.

Circle 9472 opposite back cover.

Controlled-capacity chemical feed pumps catalog

Design and construction data on controlled-capacity chemical feed pumps are given in Catalog 200. With a repetitive metering accuracy of ± 1%, the pumps are used to move specific volumes of fluid into high and low pressure systems. American Meter Co., Pump Div.

Circle 9473 opposite back cover.

Packaged boiler catalogs

Two 8-page Catalogs "Packaged Boiler and High Temperature Equipment for Heating and Process Loads" feature complete discussion and sketches of recommended boiler room layout for compact and efficient utilization of space. Cleaver-Brooks.

Circle 9474 opposite back cover.

Flexible couplings catalog offers tips

Misalignment is described; the customer is assisted in selecting a coupling suitable for his requirements; loads are classified in a new way; and various types of couplings are grouped for easier selection in 48-page Catalog 60. The Thomas Flexible Coupling Co.

Circle 9475 opposite back cover.

Shows heavy-duty transmissions

Heavy-duty transmissions with input torque capacities of 150 to 2500 ft-lb are described in 8-page catalog. Examples of standard single speed, multiple speed and right-angle drives are illustrated with complete lists of input torque capacities, speeds, and gear ratios. Cotta Transmission Co.

Circle 9476 opposite back cover.

Salt bath furnaces

Eight-page Bulletin 151 describes the unique advantages of the exclusive graphite "continuing" electrodes in salt bath furnaces. High and low temperature salt bath furnaces for any production, pilot plant or laboratory use is also described. Salt Bath Furnace Division, Lindberg Engineering Co.

Circle 9477 opposite back cover.

Self-sealing couplings, hose, fittings catalog

Industrial Catalog No. 204 contains descriptive information about hose, fittings, self-sealing couplings and related products. A hose-selector chart is included listing the various applications and fluids for which specific hose types are recommended. Instructions for ordering and assembling hose lines are also provided. Aeroquip Corporation.

Circle 9478 opposite back cover.

Hose and fittings

Fittings and hose catalog for industrial applications contains eight sections on: single-wire braid hose construction and specifications; single-wire braid hose fittings; single-wire braid medium pressure hose assemblies. Double-wire braid hose and fittings for high-pressure assemblies are likewise discussed. Final sections cover hose adapters and swivels and single-wire stripped cover hose and fittings. Lenz Co.

Circle 9479 opposite back cover.

How to insulate hot underground pipe

Four-page news bulletin tells how a New York City housing development is using a mineral insulation on underground steam lines to save money in installation, in reduced heat losses and in maintenance. Another story in this "Pipe Insulation News" vol. 3, no. 2, gives steps and instructions for proper construction and use of "leap frog" insulation forms in trenches. American Gilsonite Company.

Circle 9480 opposite back cover.

Cable connector

Welding cable connector with a patented locking action is described in Bulletin W-32. Connector will not overheat or arc; joins with a twist of the wrist; and has no moving parts—no springs, no catches, no snaps. Two sizes are available: Model 120 for 1/0 and 2/0 cable, and Model 340 for 3/0 and 4/0 cable. Ampco Metal, Inc.

Circle 9481 opposite back cover.

V-belt drives feature new concept in size

Thirty-six page Bulletin No. 9102 describes V-drives said to reduce overall drive dimensions by as much as 50%, save up to 25% in weight and up to 30% in cost over conventional drives. Catalog includes drive-selection tables for stock and non-stock sheaves, horsepower tables, nomographs for service-level comparisons of drive costs, sheave and belt specifications, bushing and keyseat specifications, and installation instructions for sheaves. T. B. Wood's Sons Co.

Circle 9482 opposite back cover.

Simplifies meter selection

Selection of precision meters is simplified in 20-page catalog. Current, voltage and high resistance (megohm) meters, available in portable, panel and bench models, are listed. Greibach Instruments.

Circle 9483 opposite back cover.

Pneumatically actuated Saunders valves

Pneumatically actuated Saunders valves are discussed and illustrated in 8-page Bulletin HB-7. Included is a section on valve sizing and flow coefficients which aid in proper selection. Conoflow Corp.

Circle 9484 opposite back cover.

Forced-draft burner units are packaged

Forced-draft square-heat packaged boiler burner units for oil, gas or combination firing are described in 4-page Form No. 1145. Illustrated with photographs and line drawings, the bulletin contains ratings, dimensions and technical data in easy-to-read tables. Also included are a typical specification and a list of standard factory-mounted accessories. American-Standard Corp.

Circle 9485 opposite back cover.

Metal-clad switchgear

For each of two types of air circuit breakers rated at 5kv, 350mva and 15kv, 1000mva, 8-page Bulletin 3-450 gives complete information on applications, construction, and breaker and cell design. Amply illustrated, the catalog contains photos of both the breaker and cells, with special illustrations of such components as closing solenoid, puffer assembly, arcing contacts, and primary and secondary disconnects. Mounting information is also included. Federal Pacific Electric Co.

Circle 9486 opposite back cover.

NEW LITERATURE

for effective plant and equipment maintenance

Brick floor repair

Repair of joints in worn or corroded brick and tile floors is described and illustrated in seven steps in Bulletin E-37A. Bulletin also shows how a mortar will produce tight joints and lower maintenance costs for brick and tile floors. Master Builders Co.

Circle 9487 opposite back cover.

For motor maintenance

Product catalog lists and describes line of items designed to eliminate high repair costs and keep motors at top efficiency. Products include resurfacers, flexible abrasives, precision grinders, brush seaters, commutator cleaners, and mica undercutters. Ideal Industries, Inc.

Circle 9488 opposite back cover.

Easy way to protect metals galvanically

Four-page "Galvanox" Bulletin explains ways to provide galvanic protection to metals using a special zinc coating applied as a paint. Applications discussed include general galvanizing replacement and reconditioning, use with cathodic protection systems, use as an electrical conductor and as a metal filler. Subox, Inc.

Circle 9489 opposite back cover.

Metal treatment stops rust

Metal treatment which, when applied to rusted metal, chemically changes the rust into iron phosphate—producing an inert, hard, gray surface—is described in 4-page "Metal Treatment" Folder. Rusticide Products Co.

Circle 9490 opposite back cover.

Welding and cutting torches listed

Gas welding and cutting hand torches are pictured and described in Form ADC 702E. Equipment listed include a general-purpose welding torch with stainless steel head and fixed-flow valves, two series of hand cutting torches, four cutting attachments, kits for utility flame heating applications, natural gas heating and brazing tips, and a wide variety of cutting and washing tips. Air Reduction Company, Inc.

Circle 9491 opposite back cover.

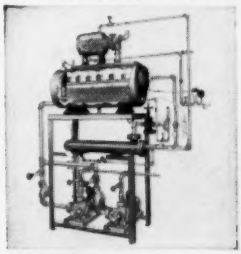
specialists

in complete condensate handling and boiler feeding systems

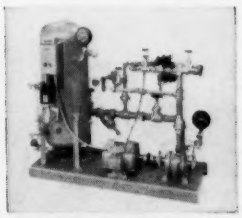
SCHAUB

stays with you from start to "phase-out"

TYPICAL COMPONENTS



ZERO-OXYGEN DEAERATING SYSTEMS
Guaranteed oxygen removal to .005/cc liter under 10-to-1 load swings, up to 250,000 lbs./hr. Other deaerators for smaller needs.



QUIK-TEMP HEATING AND DRAINAGE SYSTEMS
Continuous steam and air removal eliminates steam traps and drainage device maintenance.

1. **YOU STATE YOUR NEED**—with no "ifs" or "buts".

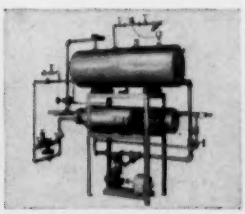
   For instance, you may need a complete condensate handling and deaerating system, starting with outlying condensate return units discharging to a central surge tank. *Plus* transfer pumps with sequence controls to feed the deaerator itself. Finally boiler feed pumps and the controls to make the whole system work — with any degree of automation you require.

2. **SCHAUB WILL ENGINEER AND DELIVER** you such a system — or any part of it — and underwrite its continuous performance. All components are "phased-out" to work together as an integrated and balanced whole.

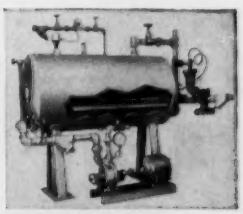
3. **OR WE WILL SUPPLY** you with individual packaged units — from pumps to console blowdown systems — to expand, augment or improve an existing system.

This is what we mean by Schaub "one-source" responsibility. From concept, through design to installation and service, you go best when you go Schaub — *all the way.* Hundreds of Schaub owners and engineers agree!

PACKAGED CONTINUOUS BLOWDOWN SYSTEMS
Automatic flash heat recovery, timer flush, sample cooling, drain after-cooling, high level shutdown, for any number of boilers.



HEAT RECLAIM SYSTEMS
Save about 10% on fuel with large percentage high pressure return systems.



PREE-HEET SYSTEMS
Stretch boiler capacities during peak loads while maintaining optimum pressures. Prolong life of boilers and return lines.

FACTORY-TRAINED REPRESENTATIVES COAST-TO-COAST. SPECIALIST ENGINEERS TO ADVISE, SUPERVISE INSTALLATION AND INSTRUCT IN MOST EFFICIENT OPERATION.

FRED H. SCHAUB ENGINEERING CO.
2115 S. Marshall Blvd., Chicago 23, Illinois

Please send my copy of technical data and Catalog No. 55-D.

NAME_____

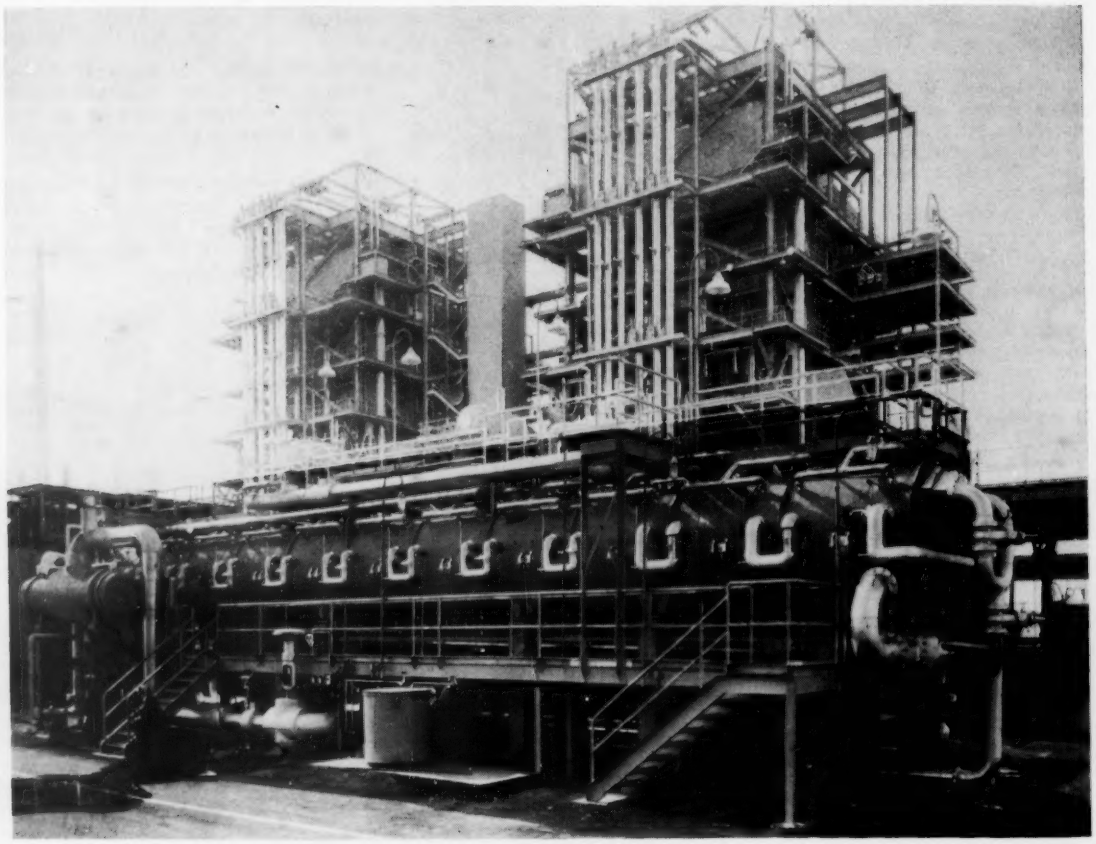
CLIP AND ATTACH TO YOUR LETTERHEAD

For more information, circle 9492 opposite back cover.

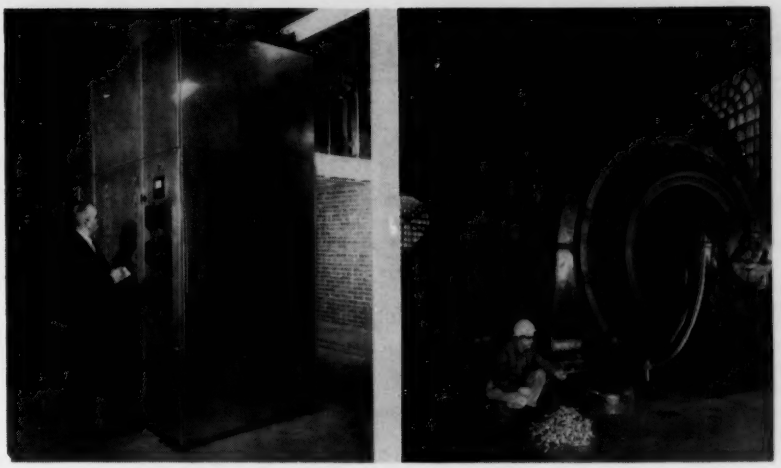
PHOTO NEWS

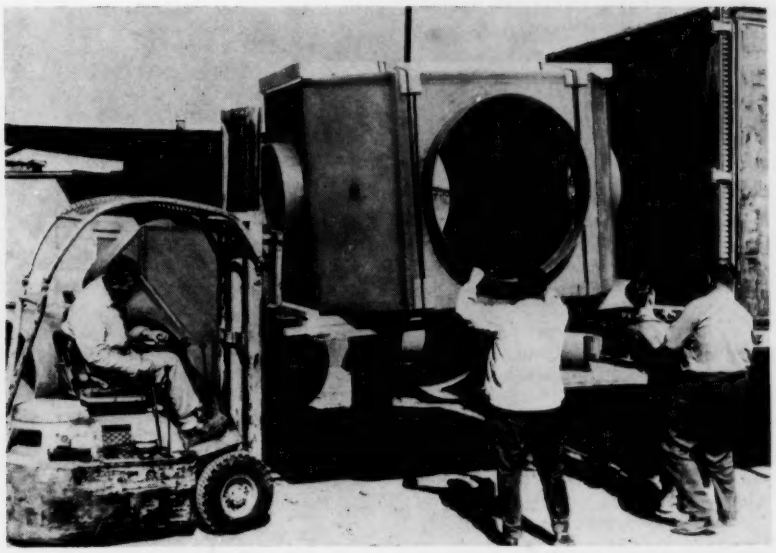
SKYLINE ADVERTISING is provided by this colorful water tank at the Libby, McNeill & Libby plant in Chicago. The special structure — a king-size replica of a corned beef hash can — will hold 100,000 gallons of water to supply the plant's sprinkler system in case of fire. Reverse side of the 130-ft high steel tank — designed and built by Chicago Bridge & Iron Company — is painted to resemble a giant can of Libby's beef stew.

FIRST PACIFIC COAST SEA WATER CONVERSION plant has been placed in operation by Southern California Edison Company at its steam-electric plant near Oxnard, Calif. The 100,000 gallon-a-day unit was designed, engineered and manufactured by Cleaver-Brooks Special Products. The unit — first of its kind in the country to be used in conjunction with an existing steam-electric station — cost in excess of $250,000.



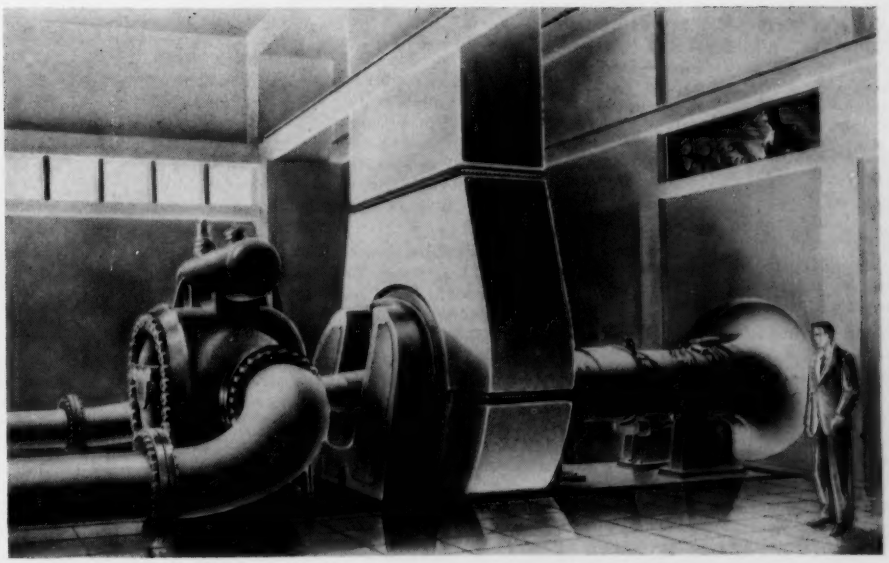
JUST AS POWERFUL BUT 1/3 SMALLER ▸ is this silicon rectifier (left) developed by Westinghouse and Alcoa for Alcoa's Badin, N.C., smelter. Called the world's most powerful, the 312-cell converter delivers 6000 kw and is rated 10,000 amps at 600v — considerably more power per cell than ever before obtained. By using high-efficiency rectifying devices (thus eliminating need for elaborate apparatus to discharge heat generated by the AC-to-DC conversion) with a corresponding reduction in number of devices needed to build the converter, engineers were able to contain the equipment in an aluminum cubicle 9 by 5 by 10 ft. Over-all efficiency exceeds 97%. The rotary converters previously used (right) since 1918 are three times this size.





◂ **MAKES A BIG JOB LIGHTER** — Substantial savings in weight and cost are among the chief advantages obtained through the use of a glass fiber-reinforced polyester resin for parts of the ventilating system installed in a midwestern metalworking plant. Providing openings up to 58 inches in diameter, this jumbo junction box was molded by du Verre, Inc., Arcade, N.Y. The resin — which also offers high fire resistance, structural strength and corrosion resistance — is Hetron 92, a product of Hooker Chemical Corporation's Durez Plastics Division.

FIRST JET-DRIVEN POWER PLANT ▸ will go on stream early this summer at the Clementsville, Ky., pipeline compressor station of Columbia Gulf Transmission Co. The gas turbine rated at 10,500 hp was developed by The Cooper-Bessemer Corporation and Pratt & Whitney Aircraft Division of United Aircraft.



FOR YOUR CATALOG FILE

AIR CLEANING

Various products and systems for cleaning gases are presented in General Catalog File. Bulletins in this file describe and illustrate multiple-cyclone dust collectors, low-draft-loss chimney fly-ash arrestors, liquid-scrubber dust collectors, induced draft fans, fly-ash reinjection systems, smoke eliminators, controlled ratio dampers and special duct work. **The Fly Ash Arrestor Corporation.**
Circle 66 opposite back cover.

AIR CONDITIONING-REFRIGERATION

For removing excessive heat at its source, rotary roof cooler works equally well by itself or in support of air conditioning. Literature tells how these devices that spray a thin layer of water on the roof are ideal for all large buildings. **Ruppright's Rotary Roof Cooler.**
Circle 67 opposite back cover.

BOILERS & STEAM GENERATION

Two-drum steam generators built to a design pressure of 725 psi are subject of Catalog 55-2. These units are adaptable to any type firing, and the catalog presents sectional drawing of four types. **The Wickes Boiler Co.**
Circle 01 opposite back cover.

Induced draft "Bifurcator" is a direct-motor-driven axial-flow fan in a divided housing that provides instant draft at starting and adequate draft during boiler operation. Bulletin DB-44, 20 pages, discusses advantages of induced draft, gives construction features of "Bifurcator", shows typical installations, and thoroughly tells with formulas, charts and tables how to select for oil-, gas- and cold-fired boilers. **DeBothezat Fans Division, American Machine and Metals, Inc.**
Circle 02 opposite back cover.

Package steam generators ranging in capacity from 10,200 to 48,000 lb/hr are subject of 10-page Bulletin PSG-3. Units are available in 175, 250, 375 psig for single or multiple use. Design and construction details are given with dimensions and weights for various capacities. **Henry Vogt Machine Co.**
Circle 03 opposite back cover.

Refuse and waste stokers are presented in 12-page Bulletin No. 510. Sectional drawings are used to illustrate and describe spreader stokers with feeders and distributors to burn refuse fuels either separately or in conjunction with conventional fuels. Actual installations are pictured. **Detroit Stoker Company.**
Circle 04 opposite back cover.

Shop-assembled water-tube boilers can be custom-engineered to your exact steam requirements, ready for immediate installation. Catalog 56-1 tells how these units are engineered for pressures up to 1000 psi and steam temperatures up to 750°F with sustained steam production up to 60,000 lb per hr. **Wicks Boiler Co.**
Circle 05 opposite back cover.

Glass-protected smokestacks that resist corrosive flue gases are subject of 8-page Bulletin SS-202A. Cost comparisons with conventional type stacks are given. Actual photographs demonstrate ease of installation. Drawings of available sections and accessories are included. **A. O. Smith Corp.**
Circle 06 opposite back cover.

Engineered boiler feed systems are described and illustrated in 20-page Catalog 55-D. Six types described include standard return systems, heat reclaim systems, spray-type return, "Pree-Heet" systems, and .03 and zero oxygen deaerating systems. Components in each system are pictured and specified. **Fred H. Schaub Engineering Company.**
Circle 07 opposite back cover.

For filling steam needs of operations which do not require a boiler with full modulating equipment, 8-page Bulletin 4010 discusses an economy line of water tube package boilers. The compact unit's built-in controls are operated by either temperature or pressure. **Vapor Heating Corp.**
Circle 08 opposite back cover.

BUILDING MAINTENANCE

Two types of safety grating are illustrated, specified and described in 24-page Catalog 5911. "Grip-Strut" type available in steel, aluminum and stainless steel features one-piece construction. The other is of I-beam and flat-bar construction, projection welded for greater rigidity and strength. **Products Division, The Globe Company.**
Circle 11 opposite back cover.

Modernizing plant stairs that are worn and slippery is subject of 4-page Brochure M-160. Available lengths and widths of safety treads to fit all steps and landings are given. Easy method of installing on any stair material is illustrated. **Wooster Products, Inc.**
Circle 12 opposite back cover.

Every grating need can be met with products described and listed in 24-page General Grating Catalog. Resplendent with application photographs, the catalog also shows each grating product in a schematic drawing. A large-size table lists safe loadings for steel gratings. **Irving Subway Grating Co., Inc.**
Circle 13 opposite back cover.

ELECTRICAL DISTRIBUTION

Heavy-duty transmission and distribution equipment is listed and priced in 300-page catalog. Detailed specifications are given for every piece of equipment, and an "Easy Estimator" is included in each of 25 sections for convenience. A special section provides motor current ratings plus generally accepted control definitions. **Continental Electric Equipment Co.**
Circle 19 opposite back cover.

Guide to electrical distribution systems is given in 60-page Speedfax catalog which provides fast-reference form to select equipment for industrial and commercial use. Three sections provide extensive information on molded-case circuit breakers, engineered substation transformers and switchgear. **I-T-E Circuit Breaker Co.**
Circle 20 opposite back cover.

For supporting cables and wires, two types of trays or tube raceways — the ladder type and the basket, small-opening type — are fully described and specified in 28-page Catalog 5912. A complete line of fittings and accessories in steel or aluminum is available for speedy installation. **Products Division, The Globe Company.**
Circle 21 opposite back cover.

ELECTRICITY GENERATION

Turbine-driven generator sets are listed and specified in four-page Bulletin 140-B. Sets are rated 3.75 to 62.5 kva, and the steam turbine features constant speed governor, excess speed safety trip, carbon ring glands, and connection to generator by flexible coupling. **Coppus Engineering Corp.**
Circle 27 opposite back cover.

A guide to selection and installation of standby electric plants is given in 8-page File Folder 32C/ON. Diesel- and gasoline-engine-driven units are available in ratings of 3 to 230 kw and 1 to 170 kw respectively. Automatic controls for transferring load to these units are also described. **D. W. Onan & Sons Inc.**
Circle 28 opposite back cover.

To obtain your copy of catalogs described in this section, circle corresponding numbers in section listed under "Catalogs" on the Reader Service Card opposite back cover.

EQUIPMENT MAINTENANCE

For testing electrical insulation, dielectric test sets supply and measure DC voltage up to 100kv and output current up to 20ma. Sixteen-page Bulletin 32 tells how to use and describes two models for non-destructive tests on electrical insulating materials, individual insulation structures and insulation of electrical equipment such as cable, rotating machinery, dry-type transformers, switchgear, capacitors, resistors and communication equipment. **James G. Biddle Co.**
Circle 30 opposite back cover.

Portable high-current test instruments for testing and calibrating take the guesswork out of electrical protection of motor starter overload relays, circuit breakers, fuse links, meters, current transformers, and oil circuit reclosers. Four-page Bulletin #356 discusses the use of these instruments. **Multi-Amp Electronic Corp.**
Circle 32 opposite back cover.

Non-destructive field testing service is explained in 4-page brochure. A suggested list of equipment needing testing is given, with illustrations of typical in-plant inspections. Magnetic particle, fluorescent magnetic particle ultrasonic "sounding", and fluorescent penetrant test systems are described. Locations of field service offices are given. **Magnaflux Corporation.**
Circle 33 opposite back cover.

All kinds of electrical testing equipment are listed in General Catalog containing specification sheets and bulletins on each instrument. Equipment includes those for testing resistance and measuring dielectric strength of insulation in circuits, panels, motors, switches, circuit breakers, cable and wiring. **Associated Research Inc.**
Circle 34 opposite back cover.

To make sure that oil-circuit reclosers meet specifications, portable test sets will check recloser operating coil size, sequence of operation, and time-current characteristics. Eight-page Bulletin SB-OCR-1 describes three units rated 4, 7.5 and 15 kva. **Multi-Amp Division, Multi-Amp Electronic Corp.**
Circle 35 opposite back cover.

Tube cleaners and expanders and other precision-made maintenance tools are illustrated and specified in 8-page Bulletin No. 58. Illustrations show how to use the equipment, and description of each type tells where and when to use. **The Airetool Mfg. Co.**
Circle 36 opposite back cover.

FANS & BLOWERS

Resistance to corrosion is offered by line of fiber-glass duct fans at a cost lower than that of comparable metals. Bulletin A-116-A gives performance data and pictures installations of these units. **Hartzell Propeller Fan Co.**
Circle 40 opposite back cover.

Engineering data on roof ventilators are presented in 16-page Bulletin A-112C. Section is devoted to fans used in these units, and descriptions of six types of ventilators follow. Two pages of tables give air delivery rates for all models. **Hartzell Propeller Fan Co.**
Circle 41 opposite back cover.

HEAT EXCHANGERS

Heat transfer equipment in custom designs for individual applications is subject of 20-page Bulletin HE-8. Basic types are shown with sectional drawings. Exampls of film type exchangers, waste heat boilers, high pressure/temperature exchangers, and exchangers of special alloys are illustrated and described. **Henry Vogt Machine Co.**
Circle 45 opposite back cover.

INSTRUMENTS & CONTROL

You name it, and this 56-page catalog describes an automatic control to safeguard it. Catalog 860 lists over 200 products consisting of pressure, temperature, liquid level controls, relays and mercury switches. Applications include something for practically every plant and power services operation. **The Mercoid Corporation.**
Circle 48 opposite back cover.

Self-powered temperature regulators use no compressed air or electricity. Bulletin No. 620-2, 10 pages, describes line of these controllers available in a wide variety of materials of construction. Three pages are devoted to "how to size." **Sarco Company, Inc.**
Circle 49 opposite back cover.

How high the frequency? Instruments with tuned steel reeds will indicate frequency of alternating current. Bulletin 32, 20 pages, fully explains a wide variety of these frequency-meter models and accessory equipment. **James G. Biddle Co.**
Circle 50 opposite back cover.

No matter what the speed, there's a tachometer described in 20-page Bulletin 35 to measure it. A wide selection of ranges and sizes are available in 15 models. In the descriptions of many models, actual-size dial faces are pictured. Descriptions of accessories and a tester are included. **James G. Biddle Co.**
Circle 51 opposite back cover.

Magnetic and motorized valves for air, water, gas, steam, oil and refrigerants are listed and described in 24-page Catalog No. V-58. Various types are shown for each application, and the catalog has two large flow charts for determining valve size. **The Mercoid Corporation.**
Circle 52 opposite back cover.

Direct-operated solenoid valves for automatic or remote flow control of liquids and steam up to 400°F are subject of 12-page Bulletin V-6. Six types are illustrated and described. Accessories and capacity tables are presented. **The Johnson Corp.**
Circle 53 opposite back cover.

Reliable protection of machinery where stopping or slowdown may cause damage is provided by "Roto-Gard" device which indicates stopping or drop in speed. Four-page Bulletin RG-21 specifies and describes installation of this low-cost-protection device. **The Bin-Dicator Company.**
Circle 54 opposite back cover.

If you have a recording instrument — no matter which make — there's a chart for it listed in this 1960 stock list of circular and strip charts. The 92-page brochure tells which to use for each manufacturer's model number. **Technical Sales Corp.**
Circle 55 opposite back cover.

All kinds of recording instruments for electricity and speed measuring are described and illustrated in Product Catalog. Instruments specified include AC and DC ammeters and voltmeters, wattmeters, tachometers, and units for measuring kva and kvar, power factor, frequency, pressure, vacuum, and position and motion. Accessories and attachments are also listed. **The Esterline-Angus Co., Inc.**
Circle 56 opposite back cover.

For steam and water service, 46-page Engineer's Manual serves as a guide in selection of automatic controls. It presents typical applications such as domestic hot water, fuel oil heaters, instantaneous heat exchangers, storage heaters, jacket and tube cooling, pressure reducing and two-temperature hot water, and provides practical, workable systems for each. **The Powers Regulator Co.**
Circle 57 opposite back cover.

CATALOGS FOR YOUR FILES

INSULATION, THERMAL

How to make insulation effective through the use of mastics, adhesives, coatings and flashings is fully described in General Catalog. Properties and directions on how to use (in step-by-step illustrated descriptions) are given on over-a-hundred products for commercial, power, process, cold storage and marine applications. **Benjamin Foster Company.**

Circle 60 opposite back cover.

High-temperature insulation is made of hydrous calcium silicate for low k-factor, rugged service at temperatures to 1200°F. Bulletin IN-169A, 20 pages, gives properties of full size range in easy-to-read tables. **Johns-Manville Corporation.**

Circle 61 opposite back cover.

Special long-fiber asbestos makes it exceptionally suitable as an insulation material. Called "Amosite", it is subject of 40-page "Unibestos" pipe insulation catalog. Besides giving all the properties of this material, the catalog also has sections on "How to Select Insulation" and "Selecting the 'J' Factor." **Union Asbestos & Rubber Company.**

Circle 62 opposite back cover.

Already-jacketed, calcium silicate insulation comes with built-on aluminum jacketing for fast, easy, clean installation. Bulletin IN-217A, four pages, gives specifications and tells how to install. **Johns-Manville Corporation.**

Circle 63 opposite back cover.

All kinds of insulation products are described and specified in Product Catalog IN244-A, 54 pages. The booklet is divided into sections according to application (industrial & high temperature; plumbing, heating & air conditioning; refrigeration; fire brick & refractories; finishing & weatherproofing; and miscellaneous). Specifications on each product for these applications are given in easy-to-read form. **Johns-Manville Corporation.**

Circle 64 opposite back cover.

LUBRICATION

How do you want to oil it? Catalog No. 10 with 34 pages lists a variety of lubrication devices for handling a multitude of oiling jobs. Photographs, drawings, specification tables and descriptive paragraphs round out the data on a line of oil cups, oiling systems, dispensers, valves and flow indicators, oil gages and filters, and chain oilers. **Oil-Rite Corporation.**

Circle 70 opposite back cover.

Forced-feed lubricator information is given in 42-page catalog. Engineering data, principles of operation, feed and mounting arrangements are discussed along with facts about the various lubricator models. A centralized lubrication system and an alarm for safeguarding lubrication systems are also included. **Manzel.**

Circle 71 opposite back cover.

MANAGEMENT & ENGINEERING

For supporting castable linings in cyclones, hoppers, pipelines, flues, furnaces and stacks, a cellular steel mesh of hexagonal design prevents lining slump and retards erosion, cracking, blistering, pitting or collapse. The product can be used to support concrete floors subjected to heavy traffic. Two "Grid-steel" catalogs fully describe two types of this steel framework. **Irving Subway Grating Co., Inc.**

Circle 31 opposite back cover.

Custom fabrication of sheet metals, plates and light structurals is the job of this manufacturer. Bulletin No. F4, 38 pages, shows facilities and a variety of equipment fabricated there. Equipment shown includes ducts, turbine lagging, insulation jacketing, special hoppers, intake louvers, electrical enclosures, instrument cubicles, machine guards, motor and pump bases, concrete forms, tanks and heat exchangers. **The Kirk & Blum Manufacturing Co.**

Circle 75 opposite back cover.

MATERIAL HANDLING & STORAGE

"The eyes of the bin" aptly describes two types of bin-level indicators for all bulk materials. Catalog BD-15, 20 pages, tells about a diaphragm type and a rotating-paddle type for both low and high level indication to prevent over-flowing of bins, clogging of conveyors, choking of elevators and damage to machinery. Flow diagrams, charts and cut-away drawings round out descriptions of various models. **The Bin-Dicator Company.**

Circle 78 opposite back cover.

PACKINGS AND GASKETS

Simplified packing application chart is presented in 84-page mechanical packing and seal Catalog 60. Products are also classified by industry use, and the catalog is divided into sections devoted to the various applications. Boiler-room tools, gage glasses, belt dressings, cutting compound and penetrating oils are also listed. **A. W. Chesterton Co.**

Circle 81 opposite back cover.

Over twenty types of asbestos packings are pictured and described in four-page catalog, Form 76-178. Types include square-braided plaited packings, braid-over-braid and high-pressure packings, gasketing tape, rope, valve stem and sheet packings, and woven tape. **Union Asbestos & Rubber Company.**

Circle 80 opposite back cover.

PIPING, VALVES & SPECIALTIES

One trap for pressures to 600 psi eliminates need to stock an assortment of different steam traps for various pressure and condensate loads. This "Thermo-Dynamic" trap, described in Bulletin 257-B, works on a principle which uses kinetic energy of steam to close the valve. There is only one moving part. How it works is demonstrated in the bulletin. **Sarco Company, Inc.**

Circle 82 opposite back cover.

Metal hose connectors in carbon and stainless steel are shown in 8-page Catalog 539. Suggested applications are listed. Charts give installation data for each pipe size and length of connector and nipple. Available models in each material are illustrated. **Cobra Metal Hose.**

Circle 83 opposite back cover.

Traps, separators, strainers are covered in 4-page Bulletin 811. Entrainment and line separators, and exhaust leaks are shown. Several types of traps are described, including a unique combination float and thermostatic trap that discharges below saturation temperatures. Selection and capacity charts for steam, air and hot condensate are included. **Wright-Austin Co.**

Circle 84 opposite back cover.

Valve selection is content of 20-page brochure, "Choosing the Right Valve." Intended mainly as a refresher in application of basic valve designs, it illustrates and discusses service characteristics of gate, globe and check valve variations. **Crane Co.**

Circle 85 opposite back cover.

Forged steel valves, fittings in complete range of sizes and pressure classes are described in 430-page Catalog F-10. Valves, fittings, and flanges for general refrigeration service are also covered. Engineering section includes pressure-temperature ratings, names of parts, maintenance information. **Henry Vogt Machine Co.**

Circle 86 opposite back cover.

Control valves and other specialities are listed in extensive product catalog. Products described, specified and illus-

trated include: sliding-gate regulators, ductile iron regulators, pressure-reducing valves, temperature-control valves, sampling valves, and a wide variety of nozzles, valves, fittings, swing joints, and manholes. **OPW-Jordan Corporation.**
Circle 87 opposite back cover.

How good trapping can save you money leads off a 50-page Steam Trap Book. Other features of this educational handbook include discussion of the inverted bucket principle, and descriptions of open-float, thermostatic, side and bottom inlet, forged steel, compound, air and air relief types. Capacity chart, pipe sizing data, and how to select for various applications are also given. **Armstrong Machine Works.**
Circle 88 opposite back cover.

Flexible metal hose for high temperature and pressure and corrosive applications is pictured and specified in 6-page Data Sheet SSDS-625. Standard fittings and connectors for the unbraided, single- and double-braided stainless steel hose are also presented. **Allied Metal Hose Co.**
Circle 89 opposite back cover.

In tough jobs such as boiler feed water, erosive slurries, high-pressure steam and water and soot-blower applications, S-valves incorporate exclusive features for long life under these conditions. Bulletin S-1 explains these features and gives specifications. **Conoflow Corp.**
Circle 91 opposite back cover.

POWER TRANSMISSION, MECHANICAL

V-belt drives offering extreme compactness and reductions in cost are described in 40-page Bulletin A69-5A. Data and tables for selection and operation of standard drives and for designing and operating special drives are included. Horsepower ratings, service level tables, and specifications for belts and sheaves are given. **Dodge Mfg. Corp.**
Circle 90 opposite back cover.

SAFETY & FIRE PROTECTION

Protective gloves and sleeves and other equipment for use in industrial and utility electrical work are listed in 32-page "Linemens' Protective Equipment" Catalog. Each product is described and illustrated, and the catalog gives clear instructions on proper care and use. **Charleston Rubber Co.**
Circle 93 opposite back cover.

Work clothes for every need are shown in 12-page Catalog No. 201. Types described include coveralls, service coats, matched outfits, acid and caustic resistant clothes, hooded ralls, inner suits and flameproof clothes. **M. Setlow & Son, Inc.**
Circle 92 opposite back cover.

Answer to enclosure problems is given in "Safe-Gard" Bulletin. These expanded metal partition panels provide a method for easier, simpler enclosing or separating of equipment, storage or tool rooms, conveyors, and stairs. They also can be used as explosion cages. **Products Division, The Globe Company.**
Circle 94 opposite back cover.

Interior fire-fighting equipment is presented in 1960 Catalog, 28 pages. Up-to-date engineering facts and specifications are given on automatic sprinklers, high- and low-pressure CO_2 systems, smoke detection systems, dry chemical systems, foam systems, portable extinguishers and fire hose systems. **The Fyr-Fyter Company.**
Circle 95 opposite back cover.

WATER SUPPLY & TREATMENT

Over 40 test sets for making water analyses are described in two Water Testing Equipment bulletins. One lists all the sets, telling which equipment and chemicals it contains. The other tells how and why it is necessary to run the various tests. **The Bird Archer Co.**
Circle 96 opposite back cover.

To obtain your copy of catalogs described in this section, circle corresponding numbers in section listed under "Catalogs" on the Reader Service Card opposite back cover.

For making brine, two models of a brinemaking unit use an exclusive device which creates exceedingly high brine make-up rates. It completely eliminates use of gravel supporting beds or other pictures and describes the units. **Morton Salt Company.**
Circle 97 opposite back cover.

For accurate feeding of water treatment chemicals, proportioning pumps and packaged chemical-feeding units will feed systems up to 1500 psig. Four-page bulletin describes all components of these units. **The Bird-Archer Company.**
Circle 98 opposite back cover.

Accurate salt inventory in underground brine tanks is possible with "Levetrol" system. Eight-page bulletin fully describes the system and tells how it controls the liquid level automatically and in proportion to salt consumed. **Morton Salt Co.**
Circle 99 opposite back cover.

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W

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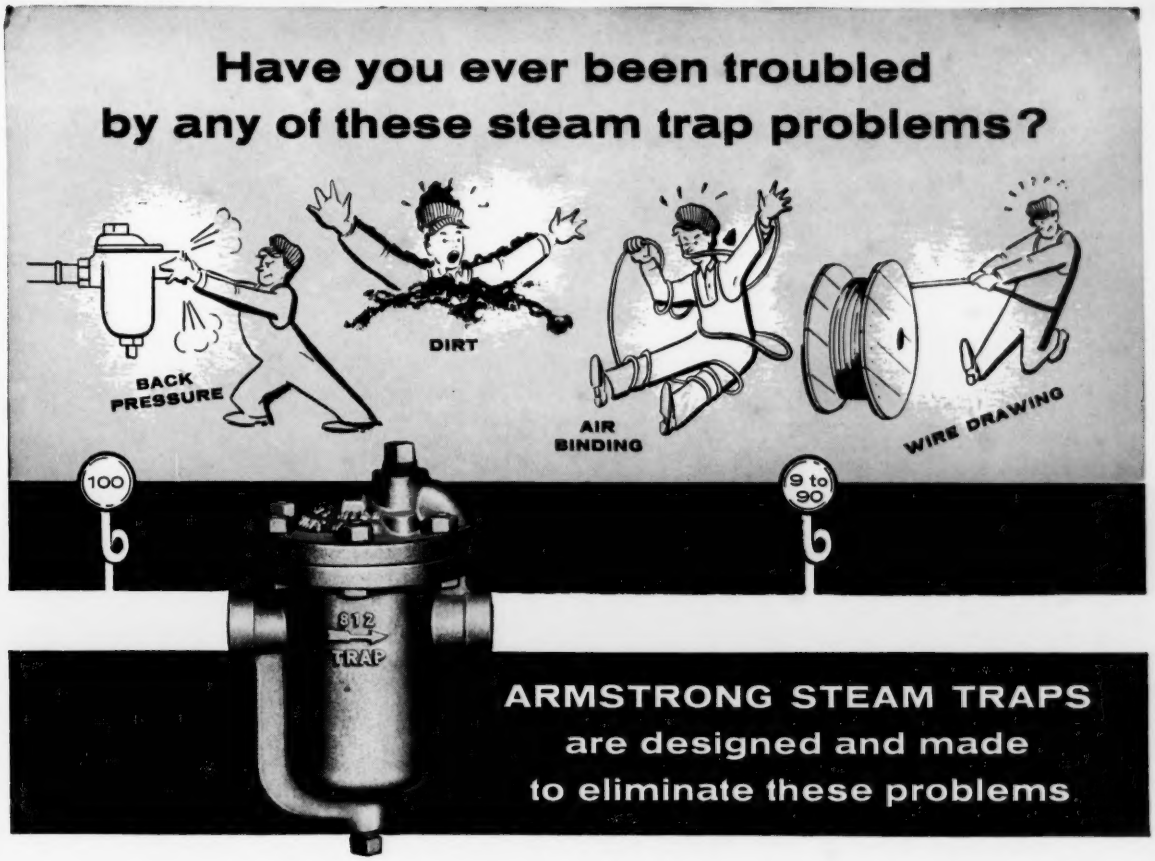
Have you ever been troubled by any of these steam trap problems?



ARMSTRONG STEAM TRAPS are designed and made to eliminate these problems

BACK PRESSURE . . . Armstrong Traps operate on any back pressure—or vacuum, for that matter. As long as there is a pressure differential across the trap, it will close on steam and open for condensate. Even the high back pressure caused by blow through of one or more traps in the system will not disturb Armstrong Traps. Other than a reduction in capacity, Armstrong Traps are unaffected by back pressure.

DIRT . . . Armstrong Traps are not affected by ordinary dirt. When the trap opens condensate swirls down under the edge of the bucket and up through the discharge orifice. Dirt is kept in suspension and discharged along with the condensate. For very bad dirt conditions, Armstrong offers traps with integral strainers. These cost less than a trap plus a separate strainer.

AIR BINDING . . . Armstrong Traps cannot air bind. Air in the system passes through a vent in the top of the bucket. It collects in the top of the trap and is discharged with the condensate. There is no chance for it to stop the trap. For low pressure on-and-off units where large amounts of air accumulate while the steam is off, Armstrong offers open float and thermostatic air vent traps in a complete range of sizes.

WIRE DRAWING . . . Armstrong Traps are designed and made to resist wire drawing. The valve and seat are tough stainless steel. The valve opens and closes tightly with a fast action and is always water sealed. There is virtually no chance for grit or sediment to lodge in the valve, virtually no chance to create conditions that lead to wire drawing.

There's no need to accept any of these problems as "inevitable." Your local Armstrong Representative can show you how to end them all. Call him today or write direct.

860 Series for low pressure heating service.

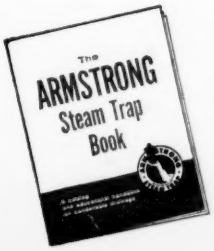
800 Series, side inlet, side outlet.

No. 801, side inlet, bottom outlet.

880 Series, integral strainer.

200 Series, bottom inlet, top outlet.

Forged Steel Series for high pressures, high temperatures.



The 48 page Armstrong Steam Trap Book tells how to correctly size, install and maintain steam traps for any pressure, any temperature, any load plus full catalog data on Armstrong Steam Traps. Ask for Catalog K.

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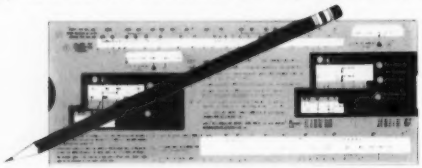
Now get fast answers to your water hardness problems

Handy new Morton Calculator gives you data at your fingertips when planning or improving hard water treatment systems.



With this amazing new calculator you can accurately determine for yourself the requirements of a water softening installation. You can quickly figure: the conversion of p.p.m. water hardness to grains per gallon hardness; the amount of exchange resin; the brine and salt requirements for maximum efficiency; and brine tank size and operating brine level adjustments.

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This Morton Ion Exchange Calculator comes to you free of charge—as do all the services of Morton's Brine Engineers, who will work readily with you on water softening problems. Their experience and service can save you time, money and labor in the planning or improvement of your water treatment system. Morton technical assistance will assure your system of maximum operating efficiency and the latest labor-saving techniques.

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